

Beginners' Artificial Intelligence & Python Programming

For Primary and Junior Secondary Schools
(GRADES 4-8)

Olubayo Adekanmbi



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Caliente.COM

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FOR PRIMARY AND SECONDARY

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Beginners' Artificial Intelligence a

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Visualisation: Yemi Shobowale & Kayode Olaniran (Karyxma M&

Typesetting: Oleksiy Serdyuk

Editors: David Dundas (UK), Julie Webb (USA) & Ezekiel Adel

Character Development: Softcom Nigeria

Production Consultant: Pius Ojemen



This book is powered by the vision of Data Science Nigeria to raise 1 million Artificial Intelligence talents in 10 years

www.datasciencenigeria.org

Published By: Xlytics Innovation Limited

ISBN: 978-0-9984014-2-3

GLOBAL REVIEWS

"Bayo Adekanmbi is a passionate communicator of his book for beginners explains many key concepts of style and engaging illustrations that speak directly basic principles of the Python programming language more about future opportunities in data science and tools they need to use."

**Professor Alan B
of Cambridge's G**

"Artificial intelligence with python programming and it is completely possible, as presented beautifully validated in the real-world successes that this book here is perfect, by first introducing interesting, useful and use cases. This goal-oriented style will motivate with the combined power of AI and coding. This is growing into this intensely digital and massively connected student should study this book!"

Dr. Kirk Borne, Principal Data Scientist and Data S

As we embark on the uncharted Fourth Industrial Revolution, contributions will come from Nigeria, Africa, on the

contributions will come from Nigeria, Africa, or the book provides one crucial pathway. Focusing on young girls to entry by creating a level playing field for girls and programming and other nuances of AI. Furthermore, appropriate illustrations makes it easy for them to understand the underpinnings of coding. Thus, we can envision how to transform societies and improve lives of the vulnerable.

**Dr. Uyi Stewart, Executive Director, Africa
Data & Analytics**

"Artificial Intelligence (AI) is no doubt changing everything around humanity. From adapting to natural language processing, AI is fundamentally changing another. At the same time, virtually every economic emerging changes every citizen including children must learn code at an early age to build logical future problems. Olubayo Adekanmbi's book, *Begin Programming*, is just the right Africa needs now."

**Prof Bitange Ndemo - Professor
and Chairman Blockchain Africa**

"AI is the most transformative technology of our time and used by many across the world. Ideally, kids can use their ideas about the future. This book is an excellent way to understand AI and take their first steps with this technology."

Dr. Richard Soch

GLOBAL REVIEWS

"As smart technology entrepreneur and AI expert with the purpose to help shape a better future in the Smart Africa, I highly recommend this excellent book by the founder of Data Science Nigeria, to introduce kids to Artificial Intelligence and stimulate their curiosity to learn more about the content presented in a very accessible, visual, and practical way, and also build an application-focused mindset. This book is a great step towards democratizing AI on the African continent and beyond."

Dr. Jacques Ludik - Founder & MD, Cortex Logic

"Reskilling and relearning are critical ingredients for the future of Artificial Intelligence. Starting early will definitely be a game-changer. This book, 'Beginners' Artificial Intelligence and Python for Africans' is a great book for Africans now. The book is presented in a very conversational and easy-to-understand fashion to simplify AI and Python programming. This book will help make Africa ready to compete in the fourth industrial revolution."

Brigitte Hyacinth - Thought Leader in AI and Data Science

"One day self-driving cars will drive themselves. You will use the knowledge from this book to build the next generation of self-driving cars."

today. Wouldn't that be cool?

"But wait," I hear you say. You don't just want to **CREATE** them? You hold in your hands the Python Programming book. It will guide you through two tools that you'll need to **CREATE** those future programming. As you work through this book, you that those magical technologies would be invented part of that ambitious dream!

Ulrich Paquet. Co-founder, Deep Learning Ind

"Artificial Intelligence, the technology that will define is often seen as a domain best left for experts or superpowers. In this formidable book, Olubayo Adekanmbi proving that AI can be taught to children in Africa AI benefits everyone and no book that achieves this Artificial Intelligence and Python Programming".

Karim

There is a palpable sense of urgency required for Industrial Revolution by urgently and greatly enhancing upskilling its people) in all the exponential technologies book, 'Beginners Artificial Intelligence and Python Secondary Schools', by Olubayo Adekanmbi, is going capacity in AI, for African children, right from the

DEDICATION

This book is dedicated to my darling wife, Toyin, who is powering our collective success; to Bolu and Folu who are the hopes, passion and aspiration to contribute to making many friends, partners, sponsors, advisory board members and Science Nigeria staff, who passionately go the extra mile.

PREFACE

The years 2015 and 2016 formed a major milestone in my full-time work and undertook academic research that required frequent trips to many emerging markets. One of the science projects that focused on bandwagon social change. One take-away for me was the huge potential in emerging markets that we can accelerate tech-enabled development through high-impact areas of social good. This was the vision of a million talented artificial intelligence (AI) specialists through a non-profit I started about three years ago.

As the realities of the Fourth Industrial Revolution become the basis for national competitiveness. Hence, it is in the first society in which artificial intelligence is effectively applied, particularly in addressing the country's sustainable development. It is an established fact that AI can and will provide a solid

established fact that AI can, and will, provide a lot of value by enhancing how we live, work and play.

By creating pervasive knowledge across the country, we are helping Nigerian to build the skills of the future. I believe that Nigeria, with its median age of about 18 years, is a huge opportunity to re-tool and reskill our young ones with relevant skills for the future. Through foreign exchange inflows, AI-enabled start-ups, and more. This will greatly benefit the lives of our citizens through solution-oriented AI applications in health, education, cities, and more. This will greatly benefit the lives of our citizens through solution-oriented AI applications in health, education, cities, and more. This will greatly benefit the lives of our citizens through solution-oriented AI applications in health, education, cities, and more.

This book is an effort towards AI knowledge democratization, making artificial intelligence in a friendly manner to our students. It caters to their curiosity and their interest in learning about AI. The book starts with the core concepts including machine learning, deep learning, and then introduces step-by-step programming using Python. My intention is to go beyond the traditional code-focused approach, helping them to understand what the knowledge of AI is, as a way to build an application-focused mindset.

I appreciate all the friends, sponsors, advisory board members, and staff of Data Science Nigeria, who continue to support the applications of AI for Nigeria's collective good. I also thank my colleagues at MTN and fellow kingdom labourers at TACEF.

Thank you, Mobolurin (Bolu) and Mofolusayo (Folake) for their support through the writing and the codes, line by line, to ensure the book is accurate and imagery relevant to the book's intended audience.

Chapter 01



In this chapter, we are going to learn

- ✓ what Artificial Intelligence, or AI, is;
- ✓ how AI is changing the world

Hello everyone!

In this chapter, we are going to explore
the wonderful world of

Yes! The world of AI is very exciting!
of AI, by the time you become an adult,
have to drive a car yourself? The world is
full of cars that can drive themselves.

Now isn't that amazing?





Fun Facts

Did you know that there are cars that can drive

Cars that can drive themselves are called 'self-'
'robocars' and they all use AI to do so.

Companies have been building and testing self-dr
In December 2018, a company called Waymo sto
cars to give rides to people in the suburbs of Ph

People are excited about the many benefits that sel

- fewer accidents
- fewer traffic jams
- less fuel
- more time for people to do other things,
read or sleep in the car while the car drive
- fewer traffic police are required on the roa
cars will obey the rules of the road.

Wow!

Self-driving cars sound aw

I can't wait to ride in c

Chapter 01

What Is Artificial Intelligence?

We have learnt that self-driving cars are able to think like humans using Artificial Intelligence (AI)...but what does AI actually mean?

Techopedia defines Artificial Intelligence as:

'an area of computer science that emphasizes the **work and react like humans**. Some of the activities are designed for include **speech recognition, learning**

(source: <https://www.techopedia.com/definition/190/artificial-intelligence>)



Now that you
think of any

Applications of Artificial Intelligence

- **Smartphones:** When you use a smartphone

Smartphones. When you use a smartphone (e.g. Siri on iPhones or Bixby on Samsung), you are interacting with AI. Virtual assistants like Siri on iPhones and Bixby on Samsung, use AI to help you. They use speech recognition to answer questions and perform tasks. The virtual assistants on our smartphones are

Did you know that Siri not only helps you to manage your day-to-day life, but she also has a sense of humour, just like a human? Ask her a question and see what her answer is.

Fun Facts

Can you remember the definition of AI? The definition is machines that 'work and **react like humans**'.

One of the ways that iPhone's virtual assistant is displaying a sense of humour. For example, if you ask 'Are you a robot?' she will respond with an answer like:

- 'Virtual assistants have feelings too.'
- 'The humanoid mind. You are inquisitive.'

You could also ask Siri, "Are you intelligent?" and

- 'I'm smart enough to know not to ans

Am smart enough to know not to and

- 'As intelligent agents go, I'm not too



Chapter 01



Figure 1:1 – Display screen showing how S

Ha, ha, ha!

Siri, you're so funny...for a n
I thought you were huma

- **Video Games:** AI has been used in **video games**. In a game such as Fortnite, you first play against real people. AI examines the human player's responses to make the game realistic, e

Just in case you haven't heard of the term

Bots are internet robots. In gaming, bots are controlled by a computer

But generally, bots are software applications on the internet for various purposes, including shopping by search engines like Google and Bing. Bots find the best deal on a particular product and interact with human users.





Chapter 01

- **Comfortable Living in Smarter Homes:** AI can help you live in more comfortable. Some people already have activated AI systems, such as Amazon's Echo, which can lock the doors.

Appliances, such as fridges, can be connected to a tablet. For example, if your mom went shopping and use her smartphone to look into the fridge at home, she can see running low on, and then decide what to buy at the store.

Mind-reading technology is also being developed. You can use your home to control appliances, such as turning on the lights, closing the curtains.

Fun Facts

The AlterEgo headset is an example of mind-reading technology. It was developed by a graduate student, Arnav Kapur, at Massachusetts Institute of Technology in the USA. It is a 3D plastic headset that you attach to your head.

When you wear the AlterEgo headset, you can control your home by thinking. You can turn on the lights, switching off the oven, ordering food, and flipping through TV channels, all without saying a word.

While it seems as if AlterEgo reads your mind, it's actually picking up tiny electrical signals that your face sends to the brain.

picking up tiny electrical signals that your face
talk to yourself. AlterEgo captures these tiny e
computer that decodes them and then acts on t

Unfortunately, AlterEgo is not for sale. It is sti
MIT is developing and refining.



Figure 1:2 - AlterEgo headset worn by it

Source: MIT News

- **Better Healthcare:** AI is already helping us
is helping doctors to quickly and easily diag
them to treat patients more quickly and save
predict what health problems a patient may
the patient's genetic history, type of food t
their age, etc.

AI is being used to detect cancer in patients
doctors decide on the best cancer treatment

Chapter 01



Figure 1:3 - How robots use artificial intelligence

Source: New York Times

- **Prediction of Natural Disasters:** AI can help predict storms and earthquakes. AI systems predict data about storms, earthquakes and hurricanes what is likely to happen next.
- **Entertainment:** Companies such as YouTube recommend videos that you might like to watch based on your past viewing history. In the future, however, it is quite likely that you will be able to choose your own choice of virtual actors.
- **Improved Policing:** AI is helping police to catch criminals. For example, it uses a facial recognition system that helps them identify suspects from a large database of faces.

small portion of person's face. In Spain, an AI system can analyze photographs from crime scenes and identify the suspects involved in crimes.



Figure 1:4 - How Robot Police is being used

Source: Gulf News

- **Fraud Monitoring:** AI helps financial companies spot patterns in a customer's transactions, suspicious activity outside of the customer's banks can protect their customers against the

Well done!

I hope you've enjoyed learning about

Artificial Intelligence!



References:

The following sources were consulted in the preparation of this book.

Beebom. 2018. 10 Examples of Artificial Intelligence in the Real World. [ONLINE] Available at:

<https://beebom.com/examples-of-artificial-intelligence-in-the-real-world/>

Forbes. 2018. Self-Driving Cars Will Keep Getting Better. [ONLINE] Available at:

<https://www.forbes.com/sites/davidsilver/2018/05/24/self-driving-cars-will-keep-getting-better-forever/#205ee80c217d>

Gammon, K. 2017. Five ways artificial intelligence will change the world by 2050. USC Trojan Family. [ONLINE] Available at: <http://trojanfamily.usc.edu/five-ways-ai-will-change-the-world-by-2050/> (Accessed 12 Jan 2019)

Gray, R. 2018. The A-Z of how artificial intelligence is changing the world. Future. [ONLINE] Available at: <http://www.bbc.com/future/article/20180912-the-a-z-of-how-artificial-intelligence-is-changing-the-world>

IBM. 2019. Deep Blue. [ONLINE] Available at: <http://www.ibm100/us/en/icons/deepblue/> (Accessed 12 Jan 2019)

McConnon, A. 2018. AI helps cities predict natural disasters. The New York Times Journal. [ONLINE] Available at: <https://www.nytimes.com/2018/01/15/technology/artificial-intelligence-disaster-prediction.html>

predict-natural-disasters-1530065100 (Access

Metz, R. 2018. Say goodbye to Alexa and hello inside your head. Technology Review. [ONLINE] [technologyreview.com/s/610949/say-goodbye-listening-to-the-voice-inside-your-head/](https://www.technologyreview.com/s/610949/say-goodbye-listening-to-the-voice-inside-your-head/) (Accessed 16 Ju

Mills, T. 2018. The impact of artificial intelligence consumers. Forbes. [ONLINE] Available at: <http://forbestechcouncil/2018/03/07/the-impact-of-everyday-lives-of-consumers/> (Accessed 16 Ju

MIT Media Lab. 2019. Project: AlterEgo - Frequency Available at:

<https://www.media.mit.edu/projects/alterego/what-is-the-state-of-the-development-can-i-be>

Protasiewicz, J. 2018. Why is Python so good for Learning? Netguru. [ONLINE] Available at: <http://is-python-so-good-for-ai-machine-learning-and-2019>).

Techopedia. 2019. What is Artificial Intelligence www.techopedia.com/definition/190/artificial-intelligence (2019).

Towards Data Science. 2018. History of AI. [ONLINE] towardsdatascience.com/history-of-ai-484a86

Wired. 2018. The Wired Guide to Self-Driving <https://www.wired.com/story/guide-self-driving>

Chapter 02



In this chapter, we are going to learn a

- ✓ patterns in AI.
- ✓ how AI uses patterns to make predictions.
- ✓ how AI learns from pattern and the past.

Join me and let's explore the wonderful world of patterns and predictions. We will learn how to learn from what has happened in the past to predict what will happen in the future.

I can think of a pattern right now! I remember

and Grade 6 play football, there is a pattern we can
know why! The Grade 5 football team and Grade 6
with their main goalkeeper, Adaeze, are playing
is held on the old school pitch.



Everything around us seems to follow a pattern, and especially regarding what has happened in the past and the future. Here are some amazing patterns that we can observe:

- The months when it tends to rain most are usually the summer months.
- It always gets dark at around 6:30 7pm, and it gets light at around 6am in the morning.
- The daily news on radio and television tend to be broadcasted at 7pm and 10pm).

Patterns are everywhere around us. For instance, we usually prefer to take the shortest distance possible. We know how Google seems to know which is the best route. When people use Google Maps to navigate, it keeps a record of the routes and the time taken. As such, over time, Google Maps identifies patterns of different routes. So, if you want to find the shortest route from your home to school, you can use Google Maps to find the best route.

patterns of different routes. So, if you want to find the fastest route, Google Maps knows which route is likely to have the shortest and quickest way to get there.

Chapter 02



Figure 2.1 - How Google Maps learns from user data

Source: UK Daily Express

Fun Fact

Scientists have shown that the average person blinks up to 1,200 times per hour and a whopping 28,800 times a day. That's more than we need to keep our eyeballs lubricated. In fact, we spend more of our waking hours with our eyes closed.

Wow! Everyone and everything we see every
sequence of patterns and if we understand
we can predict what is likely to happen
and that is what AI does so well!



As you can see, there are patterns
everywhere. It is all around us.
examples of patterns in
any patterns

How Can a Machine Learn These Patterns

Bassey, a grade 6 student, had plenty of action figures and toys. He was a bit of a hoarder, but his room was so small. One day, Bassey noticed that his little dog, Lynda, always found his toys in his bedroom. Bassey was happy each time he found a toy. He had a habit of hiding them in a place where Bassey could find them. Could Bassey build a robot to help him find his toys?

Chapter 02



Figure 2:2 – How robots can help E

Source: My Real Domain

1. At first, the robot will have to learn what Bas show the robot pictures of toys and then show When we do this, we say we are training the r
2. Also, we will train the robot to look for toys by the wardrobe and in the closet.
3. Finally, we will do a test to see if the robot ca

To make this more effective, if the robot succeed

In many ways, the robot thinks just like a human. If
time it looks in a place and finds no toys, it moves
note where it has already looked. It will keep look
the toys.

The robot will perform the same search, time and
toys are usually found in the same place, Lynda's
Lynda's bedroom to begin its search. After a few m
most times it finds a toy under the bed, so the nex
straight to Lynda's bedroom and look under the bec
found toys before.

This process by which something tries to understo
been exposed to is called **LEARNING**. If a machine
we call it **MACHINE LEARNING**!

Wow!

Machine Learning! So, for certain tasks, machi
how to successfully perform them in the sa
can. That's why machines can now recogni
know what the weather is like, and wh
happening all around it.

Chapter 02



This is how artificial intelligence works to perform a task, like drive a car or will need to carry out the same task and identify patterns to help it accomplish. A machine or robot can perform a specific way, we say that it is an

In the past, we have always given instructions to machines to perform tasks, but that is now changing. With AI, machines learn like humans. This is because, as humans, we store information. AI is also able to help machines store information in ways that are similar to humans. With the help of sensors and data on around them, think, feel and then act based on what they learn.

The way that we come to school to learn, and later on, the way we learn is similar to machine learning.

Remember the first time you learned the numbers

numbers. Even though we all have different styles still possible to recognise numbers written by different people. We will use a free online tool found at <https://machinelearningforkids.co.uk>

We will use a free online tool found at <https://machinelearningforkids.co.uk>

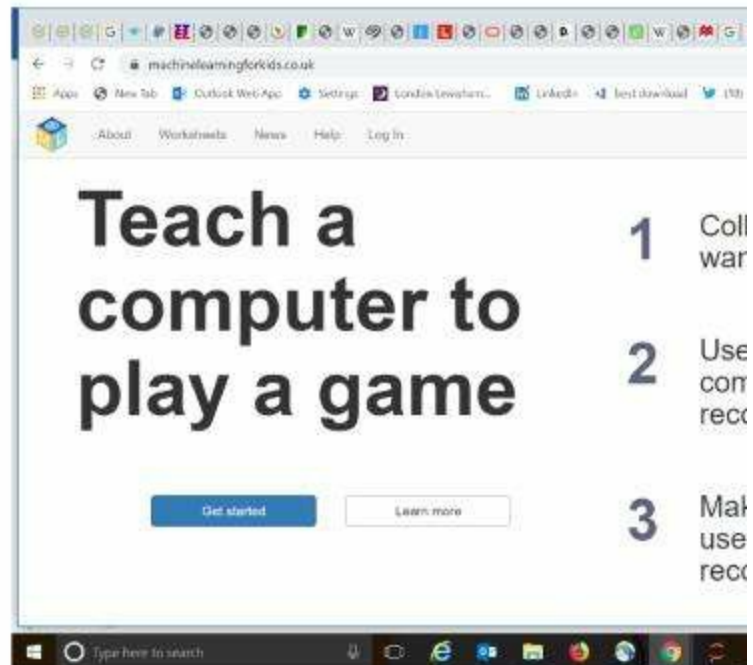


Figure 2:3 - How <https://machinelearningforkids.co.uk>

Step 1: In order to train our machine, we start by showing it examples of numbers written by people. We group these examples by digit. So, all the number 1s are grouped together. The more examples we have (this is called the training set), the more accurately it will perform.

Do you remember being introduced to a new topic by working through two or more examples. Similar to how we learn to recognise handwritten digits by having many examples.

their labels (in this case, what their number actually is).
Let's look at the examples below.

Chapter 02

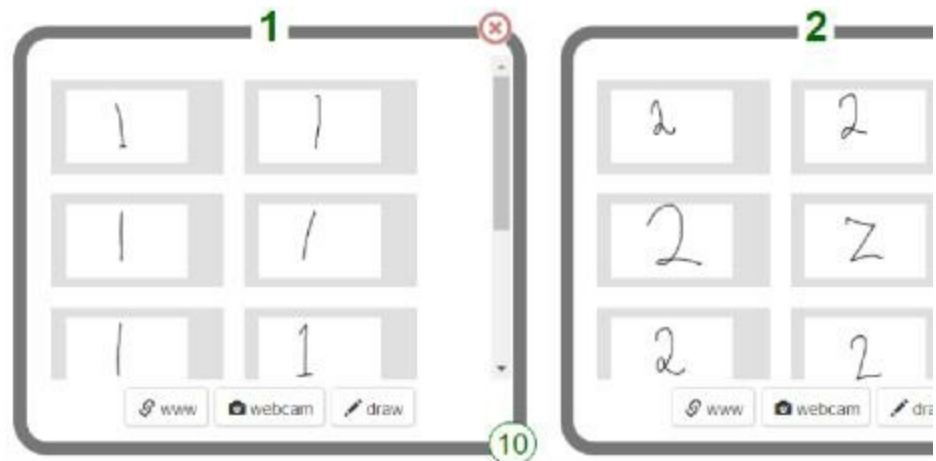


Figure 2:4 - Examples of handwritten digit

We collect as many examples as possible. The more examples we have, the more accurate the model will be. Do you know what ML stands for? It stands for Machine Learning.

Step 2: Training is a way to learn patterns by using historical data. So, we will be time to test it.

We are going to write a number (between 0-9) and see if the model can recognize it.

what number it is.

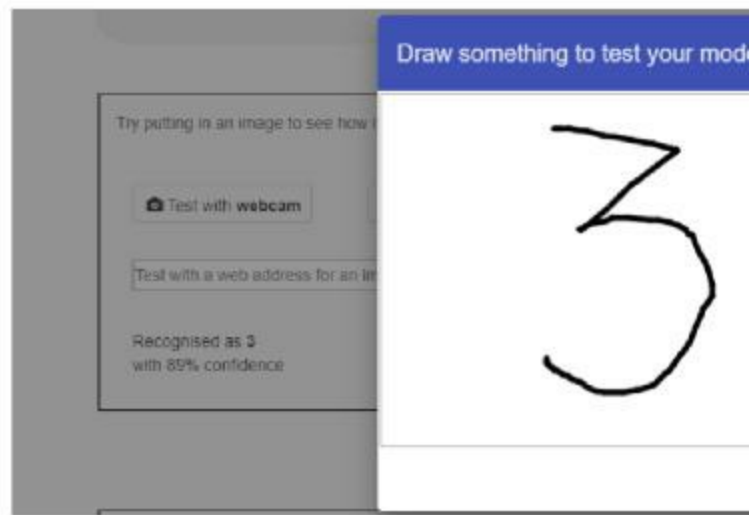


Figure 2:5 - Predicting handwritten

From the example above, our ML model was
That is a good level of confidence. Sometimes
and then we then help them learn more
It has only a 69% confidence score.

was a 3 in





Chapter 02

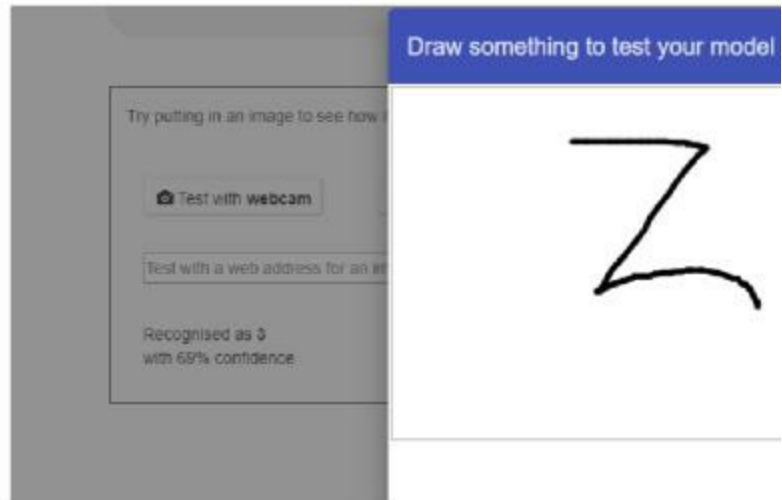


Figure 2:6 - Digit 2 wrongly recog

Can we avoid the computer making mistakes? Yes! We always have to lots of accurate data as the more data the more accurate it will become

Teaching Your Model

In the next example, let's say we want to teach a computer to identify which books are good and which are bad. But the computer doesn't know the title and content of each book in order to identify which books are inspirational and useful for learning. So we teach the computer by showing it many examples of books that are good ("positive examples") books, and some of which are bad ("negative examples").

For each category, we will also provide the computer with a set of features these are called **FEATURES**. For example, a book's title, its author, degree of academic relevance, curriculum relevance, and cover images.

| Books | Known academic author | Degree of academic relevance | Curriculum relevance |
|--------------------|-----------------------|------------------------------|----------------------|
| Believe | Yes | Yes | Yes |
| Powered to Succeed | Yes | Yes | Yes |
| Fire-Fire-Fire | No | No | No |
| Gra-Gra | No | No | No |
| BlackED | No | No | No |
| Chemistry 101 | Yes | Yes | Yes |
| ... | .. | .. | .. |

| | | | |
|---------|----|----|--|
| Lyrical | No | No | |
|---------|----|----|--|

Chapter 02

Now that we have given the computer the training formula ('model') from it. The formula is like a special code in the data. With this special code, each time the computer uses the formula or model to decide whether the data belongs to a certain class.

The way the computer makes this special code or formula from the observed data is called **MODELING**. Let us explain how it works. A number of points ('weight') is assigned if it is a YES or NO. The model then sums up the points for a given data point. It has a cut-off: if the score is above the cut-off, the model decides it's a YES; if the score is below the cut-off, the model decides it's a NO.

Summary: As you have seen, people often can discover patterns simply by being a data analyst. A machine learning model learns this same way. It looks at data and finds patterns. The information it is provided with (called features) is used to train the model.

ML models can spot patterns that good humans can't.





Aha! I have learnt that almost everything follows a pattern. Because many things have it is easy for AI to study and learn from patterns, and then make prediction

Questions and Answers

Questions

- Is a computer able to spot objects in images?
- Do some things follow a pattern, or is everything random?
- Why are patterns so important in AI?

Answers

- Yes, most objects have patterns and computers can learn to recognize them.
- Many living things, especially humans, have patterns in their behavior and actions.
- AI can use patterns to recognize other patterns and make predictions.

future.



References:

Ghose, A. (2018, 07 21). An intuitive introduction from Becoming Human: <https://becominghuman.tomachine-learning-57b2b1bd3d6>

Machine Learning for Kids. (2019, 1 1). Retrieved from <https://machinelearningforkids.co.uk>

Praagh, J. V. (2019). Recognizing the Patterns of your Life. Retrieved from www.vanpraagh.com: <https://www.vanpraagh.com/patterns-of-your-life/>

Elite Data Science. (2019). Elite Data Science. [elitedatascience.com: https://elitedatascience.com/neural-network-for-beginners/#neural-network](https://elitedatascience.com/neural-network-for-beginners/)

Thapa, R. (2018, 04 14). Basic Machine Learning Tutorial Series. Retrieved from www.medium.com: <https://medium.com/@rthapa/basic-machine-learning-tutorial-series-cabc2e1d4e0a>

Towards Data Science. 2018. History of AI. [ONLINE] Available at <https://towardsdatascience.com/history-of-ai/>

Deep Learning: How AI Learns from Photos and Sounds



In this chapter, we are going to learn about:

- ✓ how AI can recognise peoples' faces and hear sounds.
- ✓ how AI uses sounds, photos, and videos to learn about the real world.

Join me on a journey to discover how AI learns to recognize objects and patterns in photos, and sounds. Do you think a computer can detect different sounds like human voices?

Actually, yes. Just like people, AI machines can tell the difference between a grown up dog's bark and a puppy's bark, similar to us being able to tell if it is our mum or dad. Even when we can't see their faces. Some of us can hear the sounds of their footsteps, even when they are far away. We can train a machine learning model to detect and identify different types of sounds.



So, if AI can recognise content in photos, videos, and voices, what are some of the ways we can use this ability?



Chapter 03

Have you ever used a phone with a fingerprint scanner? If you have, then this is a good example. Because our fingerprints are unique, computers use our fingerprints the same way we use passwords or PINs.

Also, just like fingerprints, our voices can be used to identify us from other people. Just as fingerprints are being used as security,

Can you think of other examples?





Identifying faces,
like in the iPhone FaceID

That is very true. iPhones were the first smartphones with Face ID function. Did you know that these phones can also be used for medical purposes? Now you can see the possible uses for AI as image recognition, analyzing medical images, and videos. So, it means that AI can help in diagnosing diseases by studying patterns in many images taken of normal skin and diseased skin.

Chapter 03



If we can c
we really n

Fun Fact

Bal Gill, a 41-year-old woman, went to a tourist center of Illusions in Edinburgh, that had a big thermal camera. A thermal camera is common among tourists, and Bal was interested as Bal was going through the thermal images, she noticed a hot spot in her right chest area. She was concerned and went to a doctor. Bal was diagnosed with an early stage of breast cancer. She was able to have noticed the heat map, because thermal cameras are used in screening for diseases. Because of this, we can use thermal cameras embedded in machines that can be used for early detection of diseases.

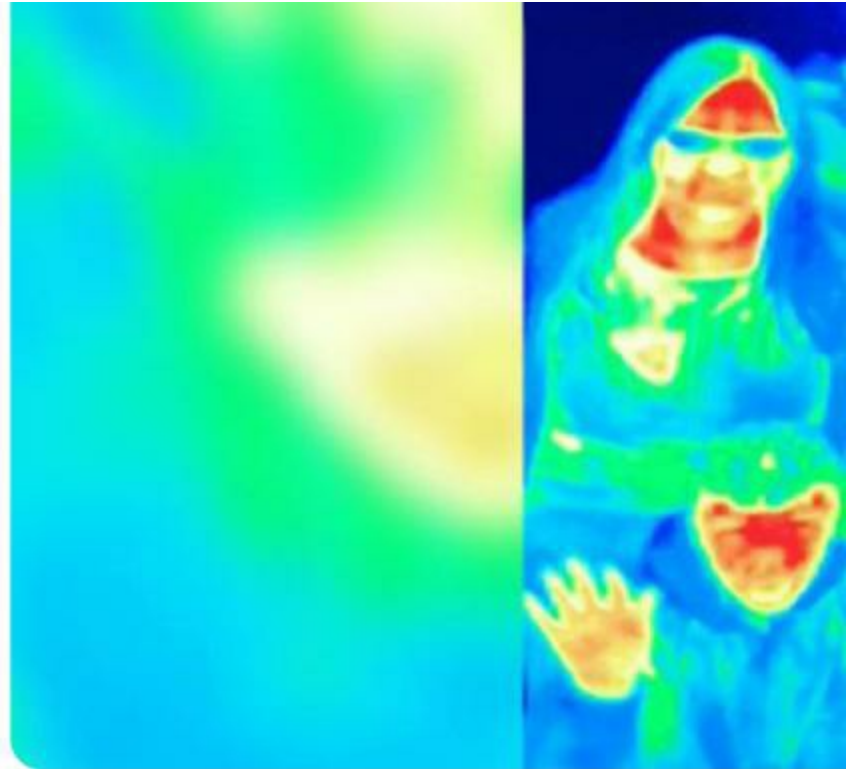


Figure 3:1 – Bal Gill image showing a heat map

Source: DailyMail.co.uk

So how does a computer recognise patterns in pictures that computers only deal with numbers. Yes, the images on computers, gadgets or our phones are all represented by numbers. This is because computers 'see' things in ways that we do. Their world consists of only numbers. Every image is a 5-dimensional array of numbers.

I wish to know how it's done, how computers can recognise objects in images or video



Chapter 03

Have you ever uploaded a photo on Facebook and Facebook suggests friends you can tag. In fact, it can identify faces of your friends from a photo. A good example of image recognition is the Google Now app. You can ask your phone to, "Please show me photos of cats." The phone will recognise that you want to see photos of cats and will open your photo library app, showing you photos with cats in them.

Wow!



How Does Image Recognition Work?

You recall what we learned about patterns. Similar to how we recognise objects, an AI machine must be shown a lot of examples of objects and then identify what they all have in common, and

in images it has never seen before.

With this, for example, we can build special machines that can recognize a cat.



Cat

Figure 3:2 - Image of a cat
Source: Quora

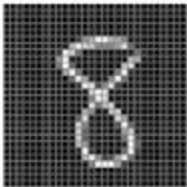
There are certain principles you must learn about how computers don't see the images like we do because they only understand numbers. These numbers are known as **binary numbers**. This means that every image is a combination of 0s and 1s before a computer can display a picture.

Every picture that you see is actually a combination of small units we call **pixels**, combined in a special layout. If we change the pixels, the image would definitely change.

Do you remember what you learned about the cell as the smallest indivisible part of matter? Similarly, pixels are small units (pixels), which can create unique patterns. Computers interpret these images.

What a machine does with any image is to break it

- and store the colour code for each pixel as shown. Each cell of the matrix represents the **INTENSITY** of a pixel (0 represents the darkest shade of black), to 255 (which represents the lightest shade of white).



Source: becominghuman

Activity 1: Image Reconstruction

We want to see how amazing the power of Artificial AI can go beyond identifying images and can actually be good at detecting human faces, we can use the Can you name a number of ways that this can be us

For example, the famous app called FaceApp make
Do you want to know what you will look like in 20 ye



Figure 3:4 – FaceApp showing how Messi and Ronaldo
Source: Sun News

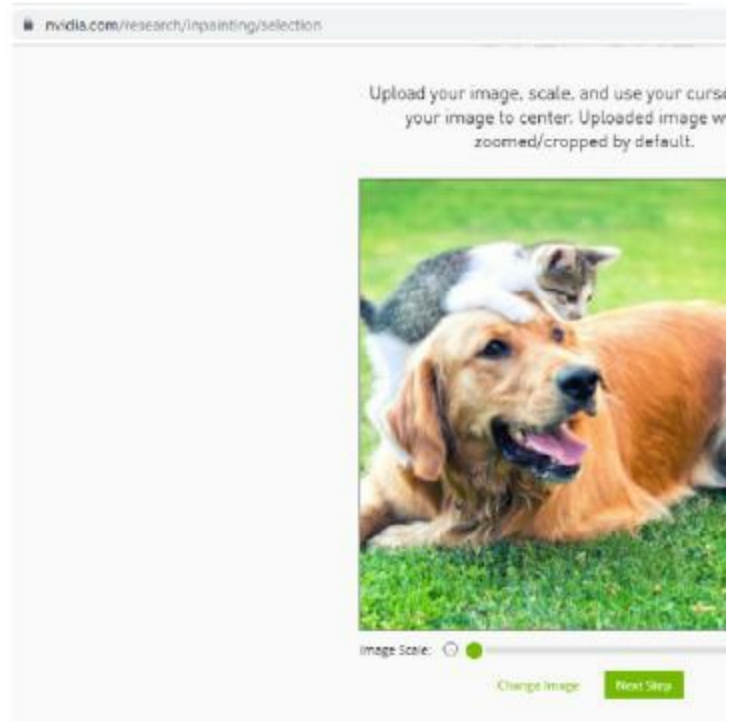
Let us do more with an online tool by Nvidia available at
<https://www.nvidia.com/research/inpainting/selection>

Step 1: To show how AI can reconstruct an image from a partial image.

For this example, we'll use an image of a cat and a dog
(<http://bit.ly/catplusdog>).

Click the link, and upload the image as shown below.
Then click **Next**.

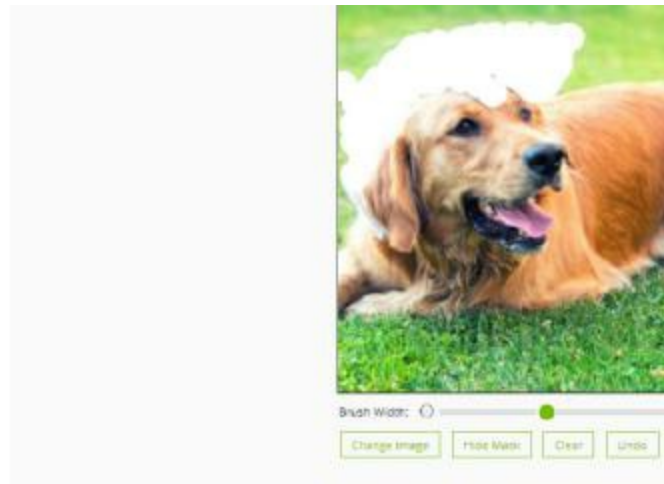
Chapter 03



Click the link, and upload the image. N

Step 2: Using your mouse, click and rub out/erase the cat. Be careful to only erase most of the cat without erasing the dog. Notice that the resulting image has an area colored gray for the AI model to try and reconstruct the image based on the picture that was taken.





Cat object deleted from

Step 3: By clicking on '**Apply Model**', the AI program in the background of the grass, and the outline of the cat.

We can see below that the AI program has recon



Image reconstructed (Cat o

Chapter 03

Activity 2: Parrot and Owl Classification /

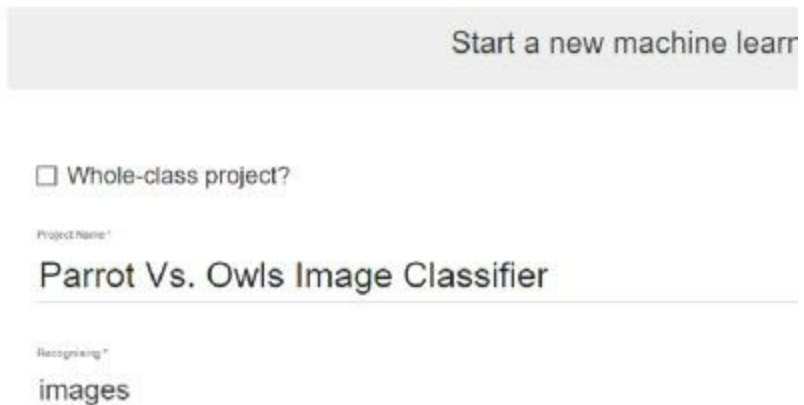
Step 1: In this activity, we will investigate how to create a program that can recognize a parrot and an owl.

In order to create your AI program, you need to visit <https://machinelearningforkids.co.uk>.

You will click **Get started**. Before you can create a project, you need to

Click '**Add new project**' and name the project **Parrot Vs. Owls**

Next, select '**Images**' and click **Create**



The screenshot shows a web form titled "Start a new machine learning project". It includes a checkbox for "Whole-class project?", a "Project Name:" field with the text "Parrot Vs. Owls Image Classifier", and a "Recognizing:" field with the text "images".

Start a new machine learning project

☐ Whole-class project?

Project Name:

Parrot Vs. Owls Image Classifier

Recognizing:

images

Image Classification

Step 2: Select the project by clicking on it, and then click **Train** to train our model. So click **Train** as shown in the

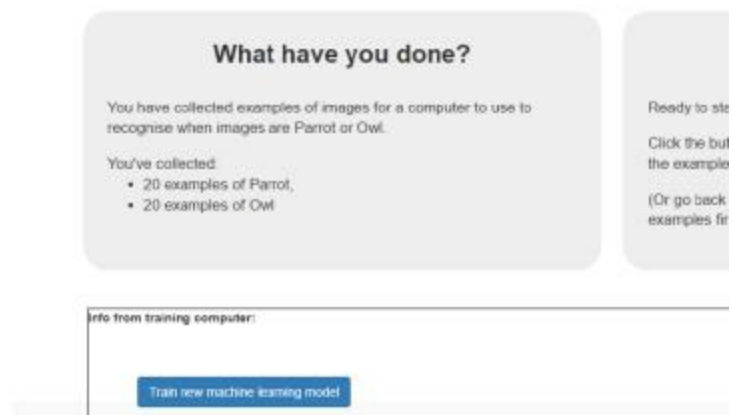
Finding training data for

Chapter 03

Step 4: Now that we have collected our data, we are ready to start training the model.

Click on **Back to project** and select **Learn and test model**.
Our model is now ready to train.

Simply click **Train new machine learning model** and wait for the training to complete.
Our model might take longer to train depending on the amount of data you have collected.
Remember, the more training data the model has, the better it will perform.



Training machine learning model

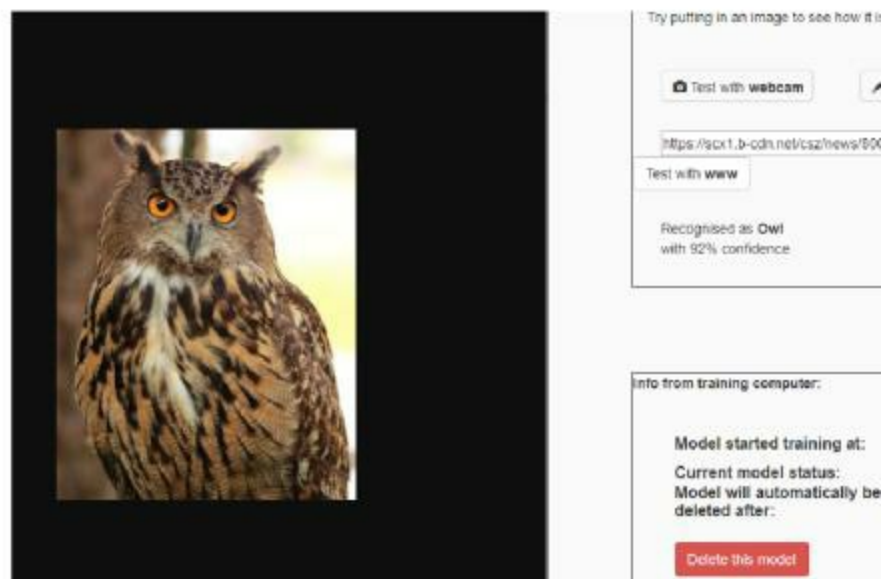
Step 5: After our model has been trained, we are ready to start testing it. Start by downloading or asking your friends for images of parrots and owls that are different to the ones you have already used in the training data.

and click **Test**.

Our model should be able to recognise a picture of

Test your models using these two images.

As you can see, our AI model is able to correctly c
(<http://bit.ly/OWLtest>).



Summary

Machines are able to represent images, or parts of
enough data, an Artificial Intelligence model can e
detect an object in an image with multiple objects.

There are models that can look at your face and a
angry, surprised, disgusted or scared. Have you
Nigeria called AI Class Monitor? It's a special cam
what subjects excite you most how often you re

what subjects excite you most, how often you read
even how often you have been dozing off in the cla

Chapter 03

I am really excited to know what AI can do to create a special robot that will help detect diseases from photos taken of their faces. AI-generated voice done in local languages has been incredible. AI can do to cure



Thumbs Up!

The reason why we learn about artificial intelligence is that I am going to create a special camera that takes photos of roads that I can learn the patterns of potholes that are likely to become potholes. I can detect obvious wear and tear from

This was a fun chapter. We have learned how to use ML to recognize images, sounds, and more. We also learned about a type of machine learning that works on images called **DEEP LEARNING**. Yes, these programs are not shallow!



Questions and Answers

Questions

- Can machines recognize images? If so, how?
- Can you mention examples of image recognition?

Answers

- Digital images are represented in computers. Special programs can find patterns in these small images and even classify objects in an image.
- Facebook suggests names so you can tag your friends. A photo app can identify (recognize) your friends from a photo so that you tag them in new photos that you take.

iPhones have a security feature, Face ID, identifying the owner's face.

References

Chollet, F. (2018). Deep Learning with Python. N

Di Palo, N. (2018, 03 12). Towards Data Science
towardsdatascience.com:

<https://towardsdatascience.com/how-i-implemented-deep-learning-in-python-d5dbaa128e1d>.

Guy, J. (2019, 10 23). CNN Health. Retrieved from
<https://edition.cnn.com/2019/10/23/health/the-international-scene/index.html>

Zhou, V. (2019, 08 08). An Introduction to Conv
Retrieved from victorzhou.com:

<https://victorzhou.com/blog/intro-to-cnns-part-1>

Chapter 04

R Ho L



In this chapter, we are going to learn about

- ✓ how AI learns from being rewarded for results, and penalised for poor results,
- ✓ reinforcement learning in AI, and
- ✓ the current and future uses of reinforcement learning.

When we were very young and were
down. After several falls, we learned
adults help us walk. Each time
However, when we did not fall
lots





I learned never to play with fire. When I was a child, my brother showed me how to put out a candle with your hand. When I tried, I got burned by the flame. He then mentioned that the trick was to do it quickly, not to let the flame burn you. It took me several attempts until I successfully learned how to do it, but when I did, my brother bought me a toy car as a reward.

That is a very good example. Humans learn through trial and error. Whenever we take a test, the teacher puts a mark to the questions we fail and full marks to the ones we get right. When we revise our wrong answers, we learn from our mistakes, and that is how we improve.

This is the same way an AI can learn through trial and error. Did you know that an AI beat a world champion at the game of GO by using Reinforcement Learning?





Chapter 04

The game of Go is like Chess, but more complex, in that the number of possible moves counts. Just like Chess, it takes years of practice to become a world champion. Google trained an AI called AlphaGo using Reinforcement Learning, and was able to beat two world class Go professional players.

Everyday, we all learn from mistakes. We become better because we don't make the same mistakes again. This is the secret of Reinforcement Learning. It's all about learning from failure after many failures.

Fun Fact

Have you heard of a man called Jack Ma? He is the founder of Alibaba.com.

His is a story of trial and errors, as he learned to be successful. He failed primary school twice and failed his university entry exam three times. He even started a restaurant called Kentucky Fried Chicken. He applied for Harvard University every time.

Now, he is one of the richest people in the world and the founder of the biggest e-commerce companies on the planet.

<https://www.ccamonash.com.au/articles/2018/1/2/jack-ma-a-story>

How Do Machines Learn from Mistakes?

Let me start with an example. There was once a baby named Halima who had two teddy bears in the cradle to play with. At one point, she wanted to go to the toilet. All she had to do was get out of the cradle.

Halima tried climbing out of the cradle, but its side was too high, so she fell back into the cradle. She needed to step on the side of the cradle.

Halima realised that if she stepped on one teddy bear, she could reach the cradle's wall. She stacked the second teddy on top of the first.

the top. Finally, Halima stacked all three teddy bears on top of each other, and she was able to climb out of the cradle to go relieve herself.

Chapter 04

Just like what happened to Halima, in reinforcement learning, given a goal (get out of the cradle and go to the door), to make progress, it has to start again (just as Halima failed to get over the side of the crib). However, for good progress towards achieving a goal, it was the happiness each time she got close to the goal (the side of the cradle). The AI machine tries all means to reach the goal (Halima kept on stacking the teddy bear to climb out of the cradle and reach the door).



So in Reinforcement Learning, The AI is free to try all means to reach the goal in the beginning. However, each time it fails, it starts again. Each time it gets closer to the goal, it receives a reward, recognising it has made progress.



That's correct. Reinforcement learning doesn't matter as long as the goal is met. to manage the traffic lights in a town, and traditional traffic lights by reducing t



Why is RL different from approaches of AI, and how we best apply it?

RL is ideal when there is a big problem space millions of possible moves in Chess and many it is difficult to define all the best moves. means we just let the AI robot play as start to get better and develop it. RL is best used when there is a problem space that is to





Chapter 04

The power of RL is because it learns patterns by receiving a reward or punishment for every action taken; therefore, it is able to adapt to unexpected environments as it has learnt patterns from experience.

Let's discuss how this is being applied in self-driving cars.

Self-driving cars use many AI-powered technologies without a driver. The car's AI analyses its surroundings and makes decisions that are safe for itself, pedestrians and other vehicles. These cars are called "autonomous", meaning they operate on their own without human intervention.



Figure 4:2 - An example of a self-driving car

Source: John P. Thomas

For a driverless car to work, it needs a lot of data to learn from.

understand patterns that can help it learn the best route to observe all the traffic rules, and make correct judgments about pedestrians on the road. To accomplish all this, the car must collect data about where the car is and what is around the car so it can choose how to respond, how best to provide transportation without causing any harm to others.

Reinforcement Learning by Adjustment

In RL, machines must be able to always adapt as the environment changes. In the same way we all had our first baby steps, we learnt to adjust our actions to achieve good results, to walk and not the punishment of frustratingly repeating the same mistakes. Machines use reinforcement learning to determine the best course of action.

For example, a robot will try different ways to achieve a goal. When it fails, it learns how to make future attempts. Once the goal is achieved, it receives a reward. Beyond learning how to walk, a robot can learn the best way to avoid obstacles or how to navigate through a complex environment.





Figure 4:3 - An example of a robot t

Source: IEEE.org

Chapter 04

Like our previous learnings, the more data we use, the less error, the better it will become at achieving its goal. It needs a lot of data, because it has to make a lot of mistakes to get right and achieve any set goals.

Reinforcement learning is used to solve many problems in automation, gaming development and other processes.

Summary

Humans have always learned from their mistakes. When something does not work out, they change their approach. When something works, we get excited and motivated. This principle applies to reinforcement learning. It is a process of trying and failing until it achieves the goal.

Have you ever been near a traffic light by a major road and the traffic light on your route was red? You were not alone. There were no cars on the other roads leading through the intersection. You were impatient and perhaps you thought that the red light was because there were no cars passing in front of you. But your lights were not.

This is one of the areas where RL is sometimes used. We can specify rules for the traffic lights. AI enables the system to learn the best outcome, which is to show a red, green or yellow light based on a learned pattern and not based on the already pre-set timing.



Figure 4:4 – An example of traffic li

Source: NSW Australi



Chapter 04

I have learnt that reinforcement learning
A machine is given a specific goal. When
machine is penalized (it has to try to
every time the robot makes good pro
back-and-forth activities form the
the machine uses to ach



Questions and Answers

Questions

- Why are rewards and punishments useful

- Can you mention any application of reinforcement learning?

Answers

- Because the machine learning model learns to reduce the mistakes it makes (punishment) that help it to achieve its target goal (reward).
- Apps are used in gaming, like playing chess; in training self-driving cars, and for training robots.

References

Gary. (2018, August 2). Towards Data Science. com, <https://towardsdatascience.com/applications-of-reinforcement-learning-in-the-real-world-1a94955bcd12>.

Marr, B. (2019). Forbes.

Retrieved from forbes.com, <https://www.freelibrary.org/php?url=https:%2F%2Fwww.forbes.com%2Fsite%2F28%2Fartificial-intelligence-what-is-reinforcement-learning-practical-examples%2F%234aca0f5d139c&sig=5>

Reynolds, M. (2017, May 5). New Scientist. Retrieved from <https://www.newscientist.com/article/2132086-go-player-in-latest-face-off/>.

Wayve. (2018, June 28). Learning to Drive in a Real World. Retrieved from <https://wayve.ai/blog/learning-to-drive-in-a-real-world>

(2016). Wonderlust Worker. Retrieved from <https://www.wanderlustworker.com/12-famous-p>

Intro

Now, we need to learn how to build our AI system starts by learning one of the most important languages in the world called Python. Python is a popular programming language and it is easy to learn.

In this chapter, we are going to learn about:

- ✓ AI and Python
- ✓ what a computer program is;
- ✓ what code is;
- ✓ how to install Python on your computer;
- ✓ how to write and save your first Python program.



AI and Python

Wow, we have learnt so much
How is Python programming?



That's an excellent
Python is not only my favourite program
the most popular programming language
quickly becoming the top choice among
on AI projects. Read on to find
Python is an excellent choice

Chapter 05

Python is quickly becoming the top choice among developers because:

- Python involves **less code** than other programming languages and use.
- Python has many **prebuilt libraries** that are available to save time when writing code.
- There is a lot of **support** available to developers. Python is open source (which means it is free) and there are many developers who are eager to help you.

Fun Fact

Did you know that there are two types of python?

One type of python is a huge snake that grows up to 30 feet long and lives in Asia, Africa, and Australia. The other python is a programming language that is used by big companies like YouTube.

There is not much that you can do with the python snake, but you can spot it in the wild. But there are a lot of super cool things you can do with Python the programming language.

Understanding What A Computer Program

A computer program is a set of step-by-step instructions to follow to carry out a task. These step-by-step instructions in a programming language are known as **code**.

Do you remember how you give directions to someone for the first time?

You use step-by-step instructions similar to how you give directions. You often use words like turn left, then go to the end of the street...look for a building when you get to the intersection, buildings from the left. This is how computers work.



These codes are part of our devices and gadgets to help us do things like:

- computer programs let you search for a contact (by name or phone number) when you want to send a text message
- when you use your laptop or tablet, it is computer code that makes it work

- play music, write documents, and search the
 - the games that you play on your game console
-

Chapter 05

Computer programs also control many other pieces of equipment, such as washing machines, televisions, cameras, and cars. For example:

- computer programs in some cars monitor and control engine performance while travelling. They also monitor the temperature and level of fuel in the tank.
- computer programs in washing machines control the washing cycle.
- Have you observed an alarm that sounds when a car's door is open? This is a program that has been instructed with codes to sound an alarm if the door belt is not fastened. That is a program that is controlling the car's security.

Note: 'Computer programs' are often just referred to as 'programs'. We often use the word 'program' in place of 'computer program'.

Software is a collection of computer programs, just as a library is a collection of books or a forest of trees when you learnt collecting.

What Is Code?

When we develop a computer program, we write out a set of instructions in a step-by-step logical order. These instructions tell the computer what to do. Without these instructions, the computer would not be able to do anything.

These instructions are known as '**code**', and the process of writing them is called '**programming**'.

The instructions, or code, must be written in a programming language that the computer understands. There are many different programming languages, each with its own set of rules and syntax.

understands. There are many different programming languages, and the programmer chooses the best language for the task.

Have you heard of the programming languages Python, Javascript and Java before?
Do you know what they are used for?

According to GitHub.com, which is a code-sharing platform for developers worldwide, Javascript, Python and Java were the most popular programming languages in 2018.

- Javascript is used to build interactive websites.
- Python is a text-based language that is used for webpages, games, and the shells of computer programs. It is also used for machine learning.
- Java is used in the development of programs for mobile devices.

Other computer languages include Ruby, PHP, C++, and C.

Fun Facts

Python is an interesting name for a programming language. It is surprising to hear that it wasn't named after the Python programming language. Python wanted to make it a program that was fun to use.

very funny British comedy group 'Monty Python

Chapter 05

How Do I Install Python On My Computer

What does it mean to install Python?
Installation (or setup) of a computer program makes the program ready or usable for execution. The good news is that Python software is easy to install, so you don't have to ask your w

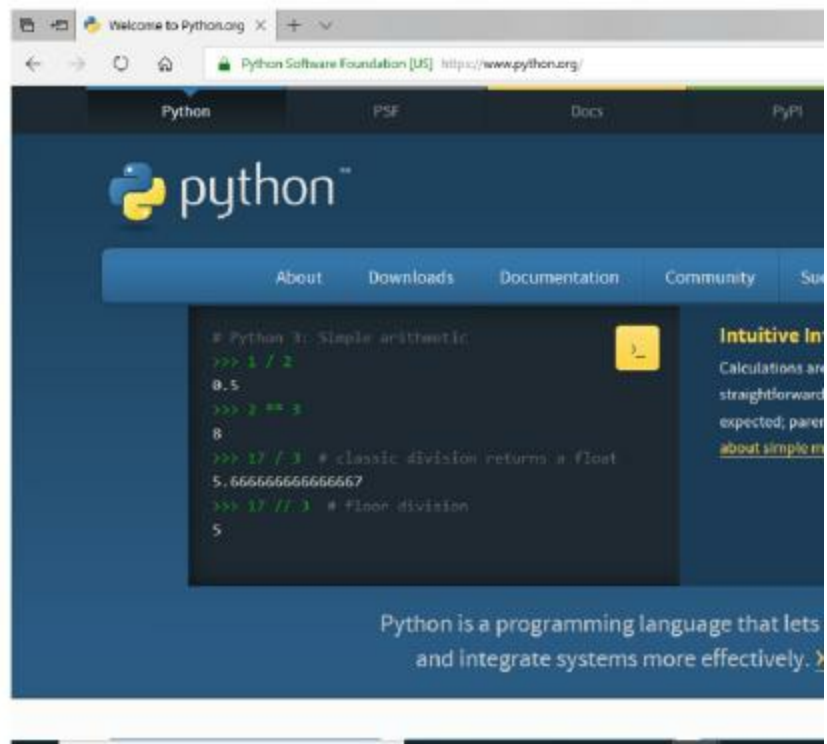


Follow these steps to install Python on your computer

Step 1: Go to the Python webpage

Go to www.python.org which looks like this:

Go to www.python.org, which looks like this:



Step 2: Go to the Python Download page
Click on the Download button.



Looking for a specific release?

Python releases by version number:

<https://www.python.org/downloads/>
release 3.6.1

Release date

Chapter 05

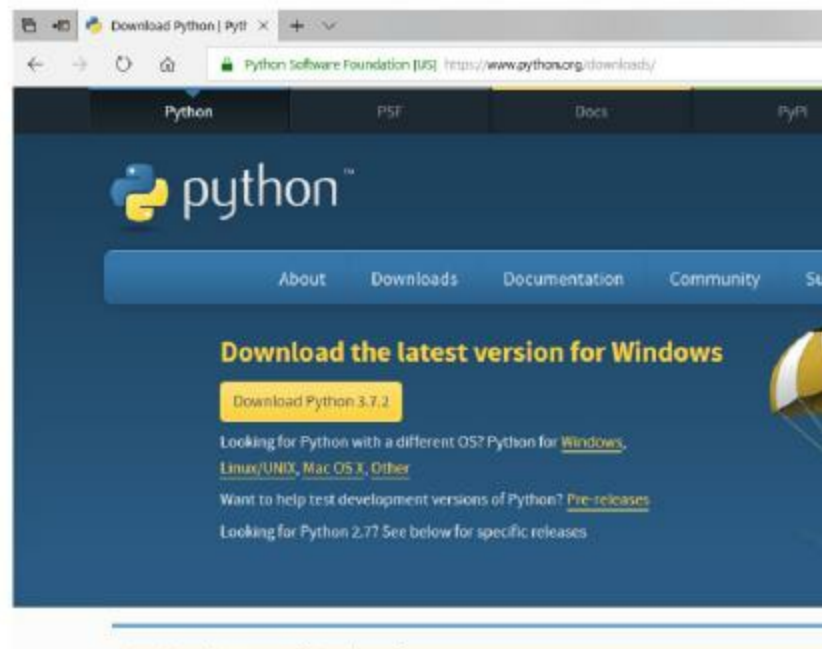
If the operating system on your computer is Windows, the button you should see is **Download for Windows**. If you have another operating system, you should see a **Download for** button for another operating system, click on **Other Platforms** to see the systems that you can download Python to (e.g. AIX).

Steps 3 - 5 below show you how to install Python for Windows.

Step 3: Download Python

On the Downloads page, click on **Python 3.7.2** (or the version that is shown in place of 'Python 3.7.2') and you will see a pop-up of your screen asking, **What do you want to do with this file?**

Select **Run**.





Note: *Only install versions of Python 3. Don't install Python 2 instead of Python 3 is like trying to go back to the future! You will have definitely outgrown it!*

Step 4: Install Python

The following screen, **Install Python**, will pop up.

Be sure to first check (✓) the boxes at the bottom.

- Install launcher for all users (recommended)
- Add Python 3.7 to PATH

Then click on **Install Now**.



Chapter 05

Python will start installing on your computer, and th



Setting up Python will take a couple of minutes to c
Once the setup is complete, the following messages



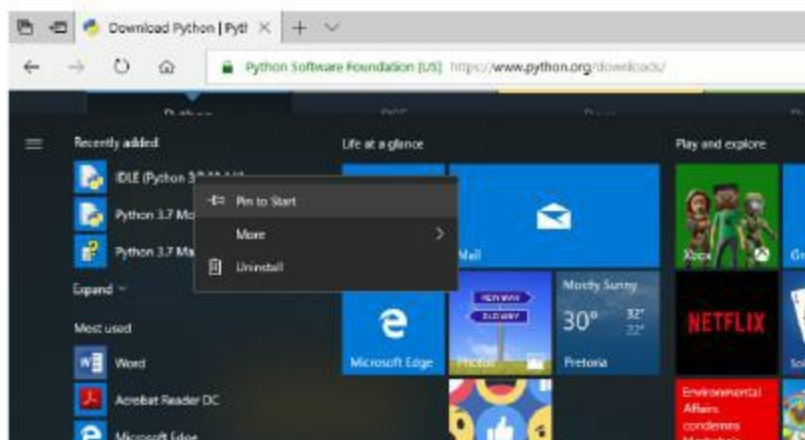


Click **Close**.

Step 5: Create a Shortcut to the IDLE Python App

To make it easy to use Python, you need to pin the IDLE Python app to the Start menu. IDLE is short for "Integrated Development Environment" and is an app that helps you write Python programs.

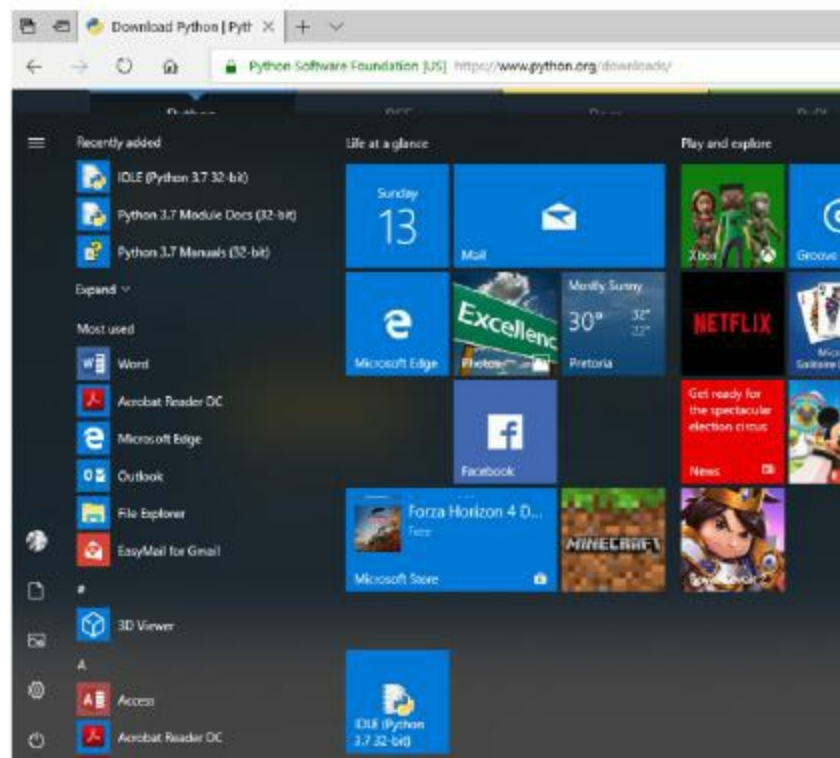
To pin the IDLE Python app to the Start menu, open the Start menu and click on the IDLE (Python 3.7 32-bit) app under the 'Recently added' section. Right click on **IDLE (Python 3.7 32 bit)**, and select





Chapter 05

The shortcut to the app IDLE (Python 3.7) will appear in the Start menu. Click on **IDLE (Python 3.7 32 bit)** to open it.



How Do I Write A Program Using Python?

To start using IDLE on a Windows computer, click on the IDLE (Python 3.7 32 bit) shortcut in the Start menu, which will open IDLE.





This is what IDLE looks like when it opens:

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2018
ntel)] on win32
Type "help", "copyright", "credits" or "license()"
>>> |
```


Chapter 05

Immediately to the left of the cursor (**|**) you will see a prompt character, which is called **the prompt**. The prompt means that you should enter some command or code.

Let's enter some information. After the prompt, type the following code:

```
print ("Hello World")
```

Make sure you include the parentheses () and the quotation marks (")

Can you imagine someone's email address without this format? It should be as name@something.com.

Any email sent without this format will not be sent. This is the same as what is used when you are writing codes in Python. You must use quotation marks in the right places.



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
help()> print("Hello World")
```

Then press **'enter'** on your keyboard and see what Python says 'Hello World' back! Isn't that supercool?

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" o
formation.
>>> print("Hello World")
Hello World
>>> |
```

The word 'print' is an instruction that we give to write on the screen what we have written in the par World". The word 'print' is a type of Python comm

Any time you use these functions, the computer kno some single word commands that your parents or te words like stop, sleep, hop, stand, silence, and clap? and teachers to make us follow specific instruction



CONGRATULATIONS!

You have just developed your first Python program!
Pretty soon you're going to be a Python expert!



Chapter 05

Fun Fact

Hello World is the most famous computer program, and the first program that is written by everyone who learns to program.

The Hello World program was first created by Brian Kernighan in 1973. Unfortunately, Mr Kernighan chose to use the words 'Hello World'. He thought he saw with a picture of a chick and an egg, and

How Do I Save My Python Program?

As a computer programmer, you will spend many hours writing programs. It is important that you save your programs so that you can use them later on.

Let's learn how to save Python programs by recreating a program and saving it. To do this:

- open IDLE, and click on **File**, and then select **new** to create an empty window, with **Untitled** in the menu bar

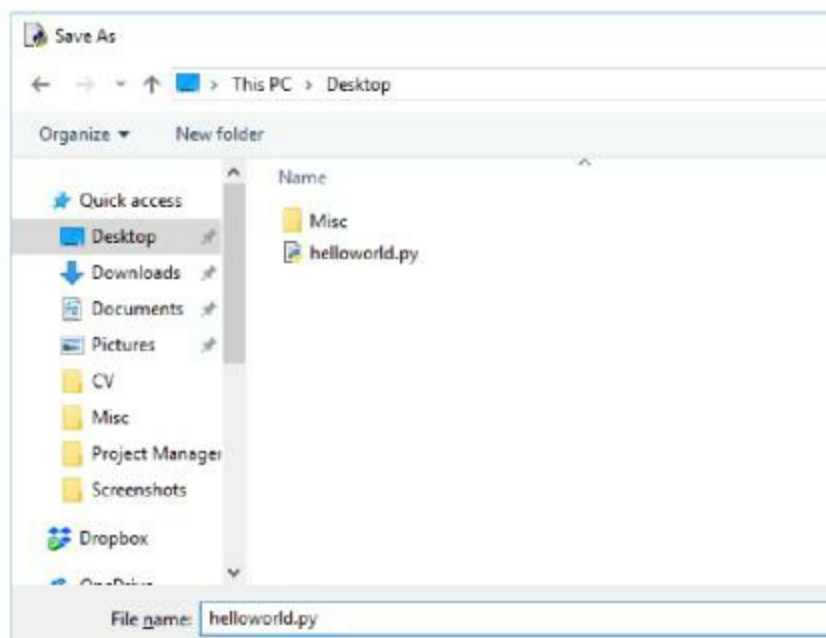


- Next, type the code for the Hello World program.



```
print("Hello World")
```

- Then click on **File**, and then click on **Save**.
- Then select Desktop or any other file of choice as the file name.
- Click on **Save**.

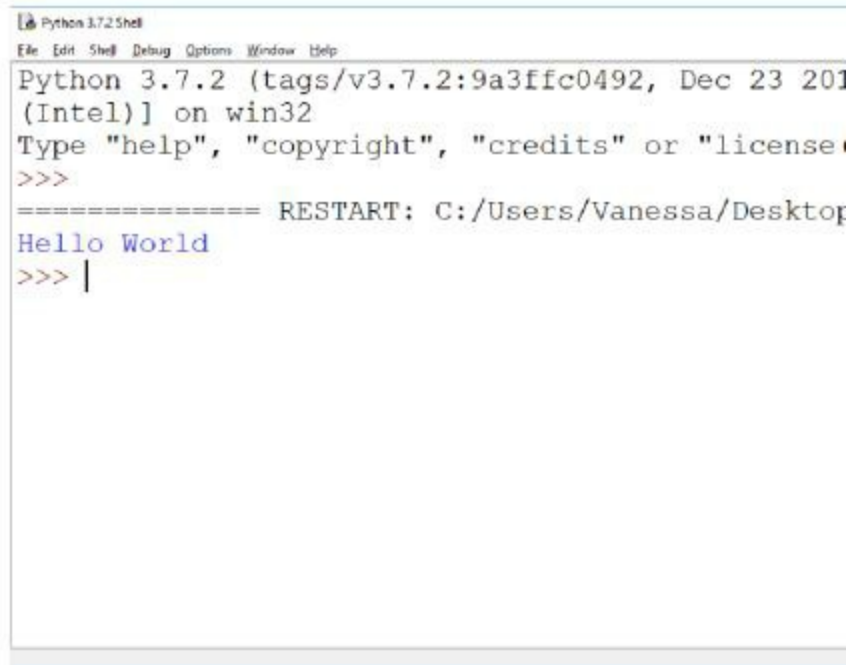


Save as type: Python files (*.py;*.pyw)

^ Hide Folders

Chapter 05

- Now select **Run**, and click on **Run Module**. You



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2018) [AMD64] on win32
Type "help", "copyright", "credits" or "license()"
>>>
===== RESTART: C:/Users/Vanessa/Desktop
Hello World
>>> |
```

References:

- The following sources were consulted in the preparation of this chapter.
- Briggs, J.R. 2013 Python for Kids. San Francisco: No Starch Press.
- Business Insider. 2018. The Ten Most Popular Programming Languages in the World. Available at: <https://www.businessinsider.co.za/programming-languages-according-to-aithub-2018-10?r=US&I>

HackerRank. 2015. The History of Hello World. |
hackerrank.com/the-history-of-hello-world/. [A]

Wired. 2010. Getting Started with Python. [ONLIN
https://www.wired.com/2010/02/get_started_wit

Chapter 06

D

In this chapter, we are going to learn about

- ✓ what expressions are
- ✓ doing Maths with Python
- ✓ fixing mistakes in Python
- ✓ what data types and variables are



In this
about ex

|



Fun Fact

Did you know that at the end of 2019, Python was the most popular programming language in the world? Python was introduced by a Dutch programmer, Guido van Rossum, though the first ever version of Python (i.e. Python 0.9.0) was released in 1990. Guido now has a special title — the Python community's "Benevolent Dictator for Life". Python programming is very popular. In fact, Python is the most searched programming language on Google who used the Google search engine in the USA. Python was also searched for US President, Donald Trump, or the word "Python". Now, that is amazing!

What Are Expressions?

I know that a smile or a frown is a facial expression... but I have no idea what an **expression** is in Python.

Chapter 06

An **expression** is the most **basic type** of
programming language

It consists of **values**, such as numbers. It also
includes plus signs, minus signs, multiplication

Expressions are always **evaluated**, or re

This is the **result** or r

Open up IDLE and

in an ex



Once you have opened IDLE, type the following after

$2 + 3$

Then press **enter** on your keyboard and see what happens! Python does the calculation! It adds 2 and 3 and gives you 5. That's that cool!

```
Python 3.7.2 Shell
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 16 2019, 32 bit (Intel)) on win32
Type "help", "copyright", "credits" or "quit()".
>>> 2 + 3
5
>>>
```

So, $2 + 3$ is an example of an **expression** in a **basic instruction** which consists of **value** 2 and the number 3) and an **operator** (the expression **evaluates** to a **single value** (5) the **enter** button on your keyboard).



Value



Chapter 06

The operator for addition in Python is the same. The operator for subtraction in Python is also the same (minus sign). However, for division and multiplication, Python uses different operators from the math symbols. The Python operator for multiplication is two asterisks, placed side by side (**). We can use the same order of operations, for example, $(6 + 2) * 3$. Remember to follow your BODMAS or PEMDAS rule!

| Math Symbol | Python Operator | Operation |
|-------------|-----------------|----------------|
| + | + | Addition |
| - | - | Subtraction |
| \times | * | Multiplication |
| \div | / | Division |
| 6^2 | ** | Exponentiation |
| () | () | Parentheses |

Using the Python Shell to Calculate Math

The Python Shell allows us to do calculations in Python. Now, let's try out some expressions in the Python Shell.

Now, let's try out some expressions, or math statements.
Open IDLE, and type in the following next to the prompt:

Type `6 + 2`

Then press **enter** on your keyboard. Python should

Type `6 - 2`

Then press **enter** on your keyboard. Python should

Type `6 * 2`

Then press **enter** on your keyboard. Python should

Type `6 / 2`

Then press **enter** on your keyboard. Python should

Type `6 ** 2`

Then press **enter** on your keyboard. Python should

Type `(6 + 2) * 3`

Then press **enter** on your keyboard. Python should

Chapter 06

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23
2 bit (Intel)] on win32
Type "help", "copyright", "credits" or "lic
>>> 6 + 2
8
>>> 6 - 2
4
>>> 6 * 2
12
>>> 6 / 2
3.0
>>> 6 ** 2
36
>>> (6 + 2) * 3
24
>>>
```

Wow! Python is really go

*From now on, I'm going to use Pytl
maths homewo*

Fixing Mistakes in Python



O
I was practising d
and it seems lik
Instead of givi
Python says 'S
What is

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 2
6 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "lic
.
>>> 8 + 7
15
>>> 8 - 7
1
>>> 8 x 7
SyntaxError: invalid syntax
>>>
```



Chapter 06

Don't worry!

You made a simple syntax error. This happens just to kids like you, but also to experienced programmers. Remember that in Python, the multiplication operator is an asterisk (*), not a dot (·).

In language, syntax refers to grammar and the way sentences are well-formed and understandable.

In computer programming, syntax can be defined as 'the **rules** that specify the **correct combined sequence**'

form a correctly structured program using a given
(source: <https://www.techopedia.com/definition/3959/syntax>)

So, if Python gives you a syntax error, it is telling you with the way you wrote an expression or statement that it cannot identify what is wrong and then correct it. For example, as `8 x 7` (which Python cannot understand), you must use `8 * 7`.

Can you imagine a student writing this sentence, "I to I to". He actually got all the five words in the sentence. This type of error also happens when you misarrange words in a sentence which you are confused when someone makes an error. Similarly, a computer becomes confused and thus flags it as a syntax error.

Fun Fact

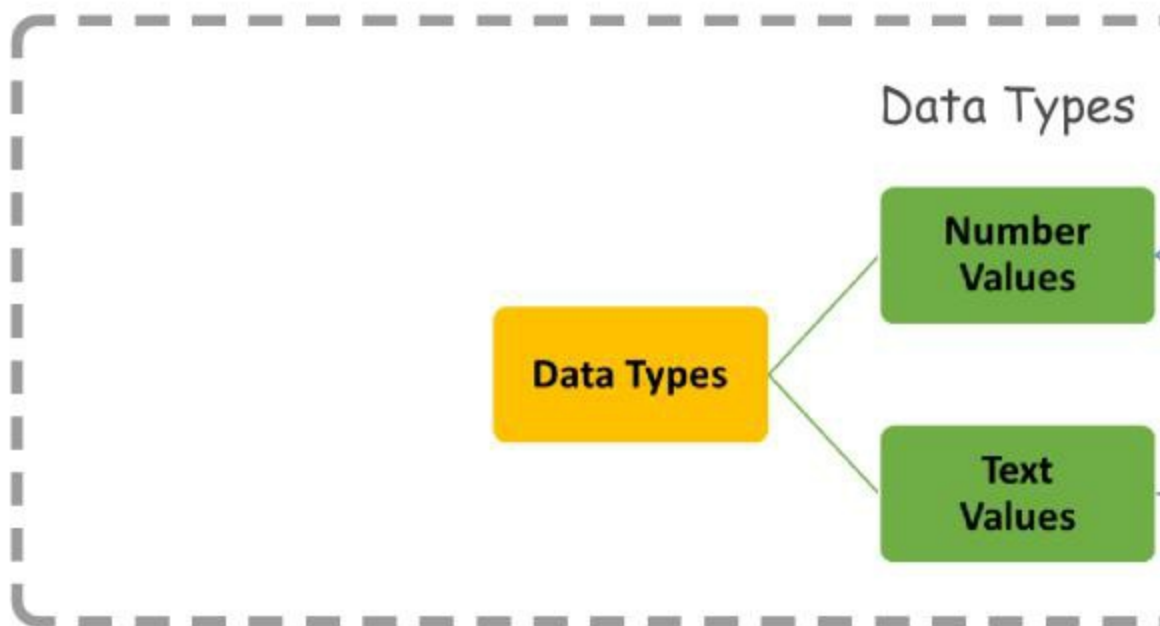
Python is a language, just like English and French. English and French are known as natural languages, because they are spoken. Python is known as a formal language because it was designed to be precise. Just like English and French, there are certain rules that must be followed for it to be understood.

Did you know that in 2015, Python overtook French as the most popular language taught in UK primary schools? Sixty percent of primary school children to learn Python rather than French, because of their parents!

Chapter 06

What Are Data Types?

All values have a **data type**. A data type is a category of data. Below is a diagram that shows the types of data types.



Integers

Integers are positive or negative whole numbers. In Python, integers are known as **ints**.

Floating-Point Numbers

Floating-point numbers are numbers with decimals. In Python, floating-point numbers are known as **floats**.

While 3 is an integer, 3.0 is a floating point number.

Strings

Text values are known as strings. For example, the three loaves of bread" are both strings. They are points. When typing strings, begin and end strings that Python knows where the text begins or ends (

Activity 1: Data Types

Hi, everyone! I have been asked to sort this data types. Can you help me, please? The data:

| | |
|--|--|
|  "Peter" |  -652 |
|  'apples' |  78 |
|  0.11111 |  "decimals" |
|  1.0 |  'numbers' |
|  1 |  333.333 |

Please use the table below to help me, sort t

Chapter 06

Help sort the data into the correct data type

| Integers | Floating-Point Numbers |
|----------|------------------------|
| | |
| | |
| | |
| | |

(*Note: The answer to this activity can be found at the

What Are Variables?

Variables are where we store stuff in Python. A variable is a container that may change.





You can use variables in expressions anywhere that evaluates to the value it contains.

Let's store some variables in Python. Open up ID prompt:

Type **x = 7** and press **enter**.

Let's see now if Python remembers what x is. Python evaluates the expression and responds with 7, remembering that x is equal to 7.



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
SC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
ormation.
>>> x = 7
>>> x
7
>>>
```

Now type **y = 2** and press **enter**.

To see if Python remembers what y is equal to, Python evaluates the expression and responds with 2!

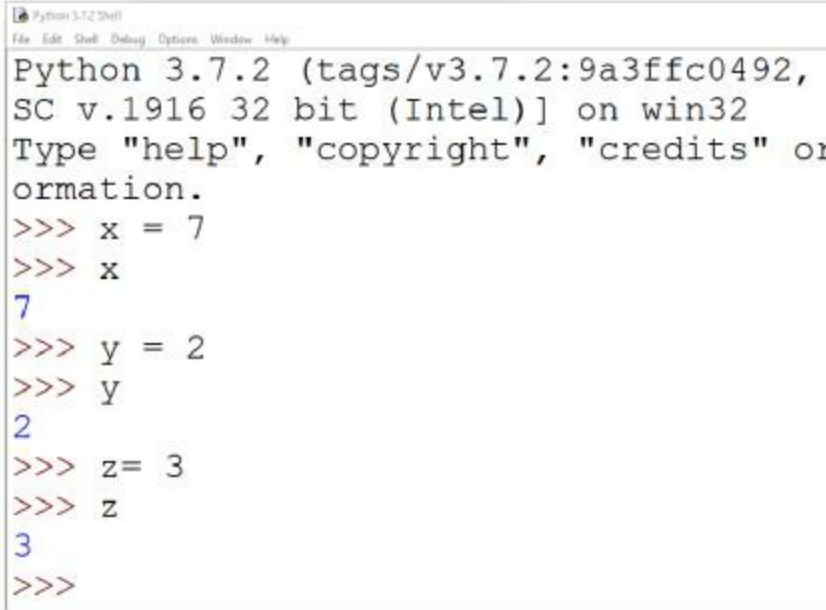
Chapter 06



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
SC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
ormation.
>>> x = 7
>>> x
7
>>> y = 2
>>> y
2
>>>
```

Now type **z = 3** and press **enter**.

To see if Python remembers what **z** is equal to, Python responds with **3**!



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
SC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
ormation.
>>> x = 7
>>> x
7
>>> y = 2
>>> y
2
>>> z = 3
>>> z
3
>>>
```


Python has remembered that **x = 7**, **y = 2**, and **z = 3**.

Python has remembered that $x = 7$, $y = 2$, and $z = 3$.


These values have been stored and we can re-use

For example:

 Now type $x + y + z$ and press **enter**.

 What does Python do? Python tells us that $x + y + z$

 Now type $x * y$ and press **enter**.

 What does Python do? Python evaluates $x * y$. Python remembered that $x = 7$ and $y = 2$.

Now type $(x + y) / z$ and press **enter**.

Python does the calculation and responds with 3.0 . For this calculation, Python first added the x and the y to get 9. Python then divided 9 by z (the value of 3).

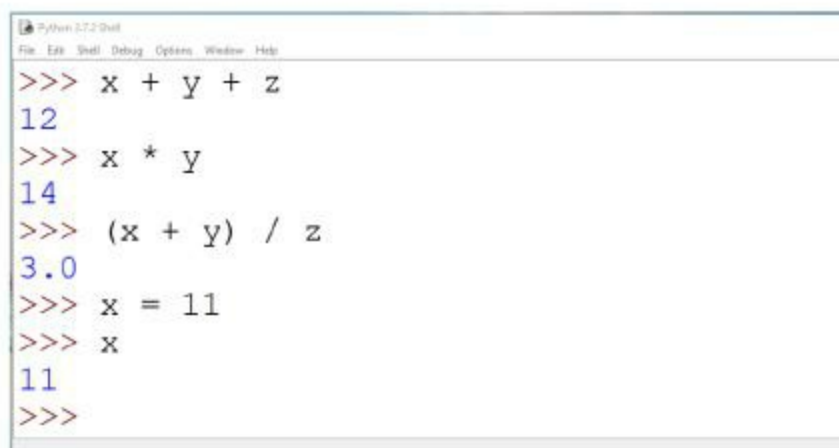
```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 16 2019, 16:07:50) [AMD64] on win32
Type "help", "copyright", "credits" or "quit()" for more
>>> x = 7
>>> x
7
>>> y = 2
>>> y
2
>>> z = 3
>>> z
3
>>> x + y + z
12
>>> x * y
14
```

```
>>> (x+y) / z  
3.0  
>>>
```

Chapter 06

If you need to change the value of any variables like example, if $x = 7$ is no longer relevant, and you need to do is:

Now type **$x = 11$** and press **enter**. To check that **enter**. Python responds with **11**. This confirms the change from 7 to 11.



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
>>> x + y + z
12
>>> x * y
14
>>> (x + y) / z
3.0
>>> x = 11
>>> x
11
>>>
```

Activity 2: Variables

For this activity you need to:

1. Open IDLE
2. Define values to variables as follows:
 - x must have a value of 9

- y must have a value of 7
- z must have a value of 23.

3. Once you have defined these values to x, y, and z, you must calculate the following:

- add x and y
- subtract y from z
- multiply x and z
- divide z by y.

(*Note: The answers to this activity can be found in the solutions section below.)

Solutions for Activity 1:

Earlier on in this chapter, you were asked to calculate the following values. The correct answers to this activity are shown in the table below.

| Integers | Floating-Point Numbers |
|----------|------------------------|
| 1 | 0.11111 |
| -652 | 1.0 |
| 78 | 333.333 |

1 _____

Chapter 06

Solution for Activity 2

Below is a screenshot, showing the



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2019)
32 bit (Intel) on win32
Type "help", "copyright", "credits" or "license()"
>>> x = 9
>>> x
9
>>> y = 7
>>> y
7
>>> z = 23
>>> z
23
>>> x + y
16
>>> z - y
16
>>> x * z
207
>>> z / y
3.2857142857142856
>>>
```

Well done!

You are well on your way to
rock star programming!

References:

The following sources were consulted in the preparation of this book.

Payne, B. 2015. Teach Your Kids to Code. San Francisco: No Starch Press.

Rossi, B. 2015. Python overtakes French as the most popular language taught in primary schools. Information Age.

[ONLINE] <https://www.information-age.com/python-popular-language-taught-primary-schools-12346>

Sweigart, A. 2015. Automate the Boring Stuff with Python. No Starch Press.

Stichbury, J. 2018. 5 Facts About Python. Big Data.

[ONLINE] Available at: <https://dzone.com/articles/python-5-facts> (Accessed 17 July 2019).

Techopedia. 2019. Syntax. [ONLINE] Available at: <https://www.techopedia.com/definition/3959/syntax>

Wentworth, P., Elkner, J., Downey, A.B., and Meyer, D. 2015. Computer Scientist: Learning with Python 3 Documentation. No Starch Press.



Chapter 07

In this chapter, we are going to learn:

- ✓ what a string is
- ✓ what a list is
- ✓ what a tuple is
- ✓ what a dictionary is



In this
learn al

Fun Fact

Did you know that Python and Google are good friends? Python is an official programming language that is used at Google. It's a very easy language to use!

Python powers a number of Google products, including Gmail. That's so cool!

Do you remember what data types we learnt about in previous chapters?

What is a String?

A String can be described as a collection of keyboard characters enclosed within quotation marks. The characters can be enclosed in single quotation marks (' ') or double quotation marks (" "). When using IDLE, Python will simply give us back what we type.

Open IDLE, and type the following after the prompt:

```
'5 + 5'
```


Then press **enter** on your keyboard and see what happens.
What do you notice? Python simply gives us back '!'.

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```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492
[MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits"
information.
>>> '5 + 5'
'5 + 5'
>>>
```

Now that's interesting! So, when we place `no` quotation marks, Python does not do a calculation. It gives us back the text.

Now, let's remind ourselves what happens if we use quotation marks. Type `5 + 5` into IDLE without quotation marks. See what happens!

```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,  
[MSC v.1916 32 bit (Intel)] on win32  
Type "help", "copyright", "credits" or  
information.  
>>> '5 + 5'  
'5 + 5'  
>>> 5 + 5  
10  
>>>
```

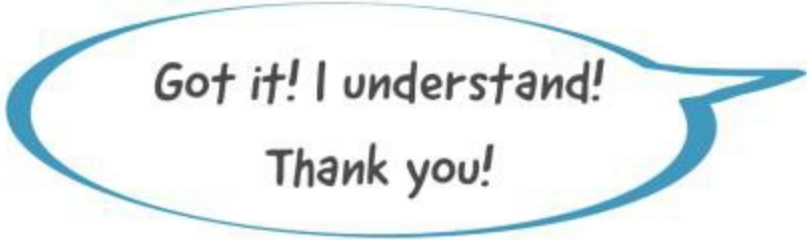
Hmm, this is interesting.
Please, could you explain?

So, if you remove the quotation marks from
Python sees the expression as one that contains
an operator and responds with an error.
It is very important that you understand the difference
between strings and integers, floating-point numbers.





Chapter 07

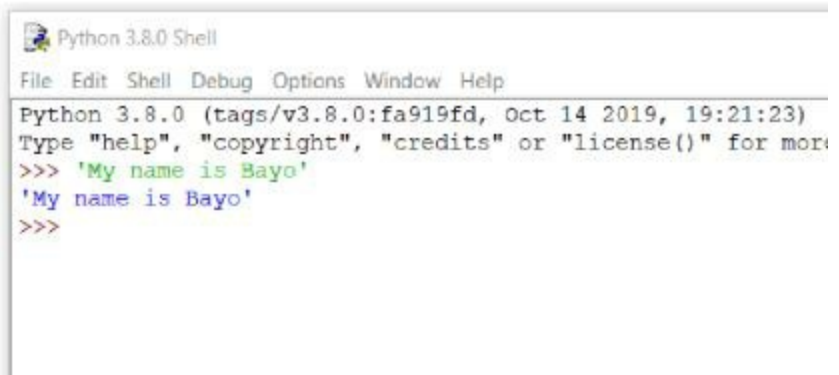


Got it! I understand!
Thank you!

We do not use strings to do numerical calculations or exchange information back and forth.

Now, let's enter a string of text characters. Next **'My name is Bayo'** and press **enter**.

What does Python do? It responds with **'My name**



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 19:21:23)
Type "help", "copyright", "credits" or "license()" for more
>>> 'My name is Bayo'
'My name is Bayo'
>>>
```

What is a String Concatenation?

Let's try something a little more complicated. Next:

'My name is Bayo.' + **'I am a Nigerian.'** and press:

What happens? Python joins the two sentences together.

'My name is Bayo. I am a Nigerian.'

This is known as **string concatenation**, where two strings are joined together using the **+** operator.

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 1
tel)] on win32
Type "help", "copyright", "credits" or "license()"
>>> 'My name is Bayo.' + 'I am a Nigerian'
'My name is Bayo.I am a Nigerian'
>>>
```



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What Is String Replication?

Let's try something else using strings. Next to the `'Abuja' * 3` and press **enter**.

What happens? Python repeats the string Abuja to the power of 3, resulting in the string `'AbujaAbujaAbuja'`.

This is known as **string replication**, where a string is repeated a certain number of times by using the `*` operator.

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019,
(Intel)) on win32
Type "help", "copyright", "credits" or "license"
>>> 'Abuja' * 3
'AbujaAbujaAbuja'
```

```
>>>
```

Storing Strings in Variables

It is possible to store strings in variables so that we can use them later in the code that we are developing.

In IDLE, next to the prompt, type in:

```
name = 'What is your name?'
```

Press **enter**, and next to the prompt type in:

name and **press enter**.

What happens? Python responds with:

```
'What is your name?'
```

This is because Python remembers that 'What is your name?' is a string and is called name.

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492
[MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits"
information.
>>> name = 'What is your name?'
>>> name
'What is your name?'
```

>>>

Chapter 07

Now, in IDLE, next to the prompt type in:

```
mycountry = 'Nigeria'
```

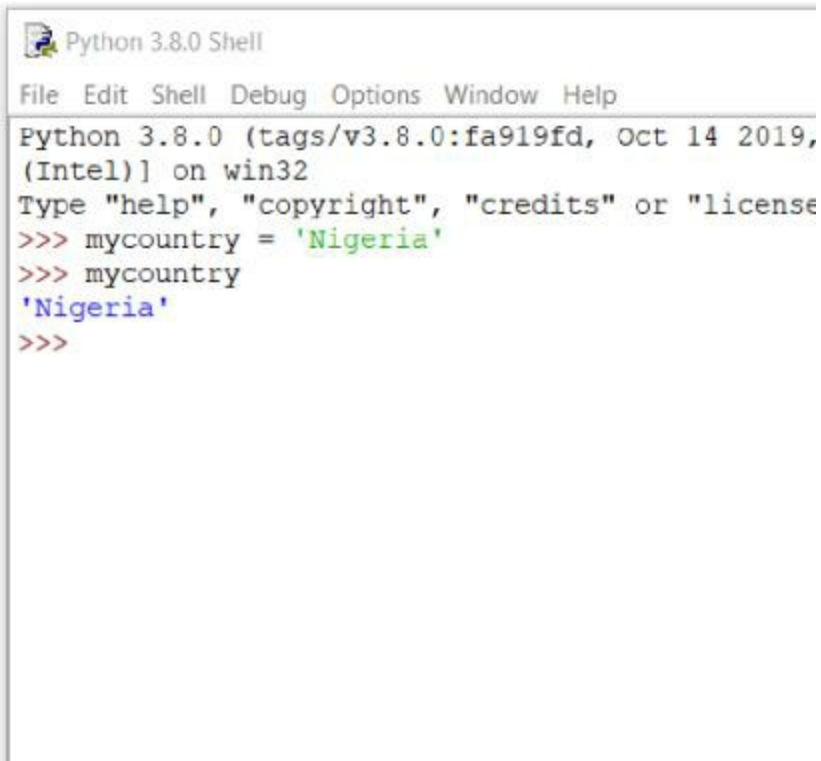
Press enter and then next to the prompt type in:

mycountry and press **enter**.

What happens? Python responds with:

'Nigeria'

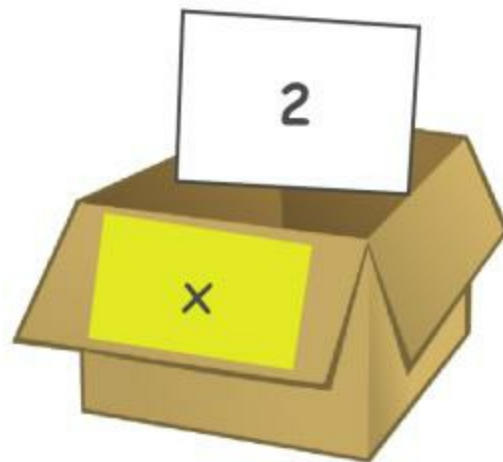
This is because Python has stored 'Nigeria' in the v



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019,
(Intel)] on win32
Type "help", "copyright", "credits" or "license()>>> mycountry = 'Nigeria'
>>> mycountry
'Nigeria'
>>>
```

What is a List?

So far, we have understood variables to be a container for a single value, such as one number or one string. But sometimes we need to store many things. For example, we might need to develop a program where names are stored in one variable. Or we might need a list, rather than in many variables.



Variable containing a
single number (integer)

Variable containing a
list

A list is a data structure. It is a way of storing a collection of items.

Lists can be changed. Once you have created a list, it is also possible to modify items in the list and remove items from the list.

... and `append()` to insert new items at the end of the list.

Lists are very useful when you need to store data.

Chapter 07

To create a list in Python, open IDLE, and next to

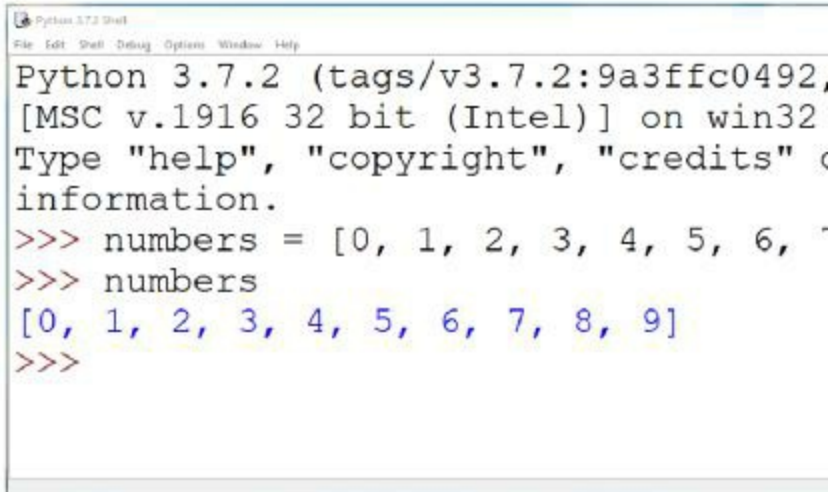
```
numbers = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

Press **enter** (this will save the list). Then type:

```
numbers
```

Press **enter**. How does Python respond? It gives us

```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
[MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
information.
>>> numbers = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>> numbers
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>>
```

Note that in Python, a list uses square brackets ([]).
in the square brackets.

Note how Python's response is not a string, as there
is Python's response a number, as numbers would be

How to Find Out the Length of a List

Lists always have a length.



I wonder
the list is
`[0, 1,`

If you look at the list carefully, you will see
between the square brackets. This means the

But you don't need to count the number of
You could just ask Python to tell you!

Chapter 07

To find out the length of the list, type the following `len (numbers)` and press **enter**.

How do you think Python will respond? Python responds it is:

10

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
[MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" c
information.
>>> numbers = [0, 1, 2, 3, 4, 5, 6, 7
>>> numbers
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
>>> len(numbers)
10
>>>
```

It is important to remember that the length of the list is 10, not 9, because there are 10 numbers in the list, but **how many** numbers there are inside

How to Access Items in a List



Did you know
accessing items in a list is easy



Imagine that you are developing a game where the need to gather food that they find on the island and

In IDLE, type in the following, which is a list of food items they find and store in their backpack. The items are added as they find them.

```
backpack = ['water', 'bananas', 'fish', 'noodle']
```

Press **enter** to save the list.

Now if you want to find out what the first item in the list is, type:

```
backpack [0]
```

Then press **enter**, and Python will respond with:

```
'water'
```

This means that the water is the first item in the list.

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 1
tel)] on win32
Type "help", "copyright", "credits" or "license()"
>>> backpack = ['water', 'bananas', 'fish', 'noodle']
>>> backpack[0]
'water'
>>>
```



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I am confused! If we want to know what item in the list is, why didn't we type in `backpack [1]` instead of `backpack [0]`? Surely `backpack [0]` should refer to no item in the list?

That's an excellent question! Python counts a little differently than humans. While humans start counting with the number 1, Python starts counting with the number 0. So, when Python counts it goes 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Python uses this way of counting to tell us of where each item in a list is. This is known as the index.





Oh, I understand now. So, item 0 is the first item in the list, and item 1 is the second in the list, and item 2 is the third. I'm so used to counting like a human that it takes me a while to get used to counting from 0.

We know that 'water' is the first item in the list, and 'bananas' is the second. Let's now ask Python what the second, third and fourth items are.

Next to the prompt in IDLE type in:

backpack [1] and press **enter** to find out what the second item is. Python responds with:

'bananas'

Now type in:

backpack [2] and press **enter** to find out what the third item is.

Python responds with:

'fish'

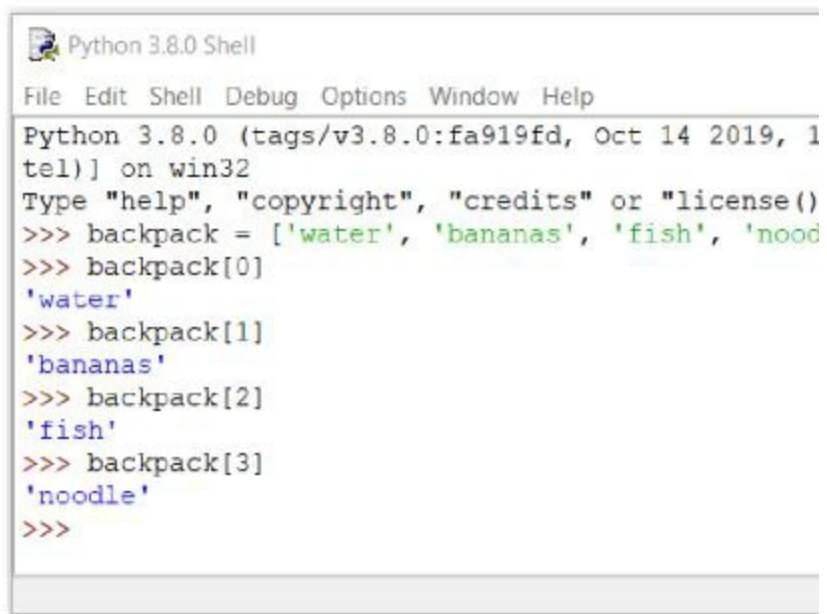
Chapter 07

Finally, to find out what the fourth item in the list `backpack [3]`

Python responds with:

`'noodle'`

So, Python has told us that the 'bananas' is second 'noodle' is fourth in the list.

A screenshot of a Python 3.8.0 Shell window. The window has a title bar that says "Python 3.8.0 Shell" and a menu bar with "File", "Edit", "Shell", "Debug", "Options", "Window", and "Help". The main text area shows the following code and output:

```
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 1
tel)] on win32
Type "help", "copyright", "credits" or "license()"
>>> backpack = ['water', 'bananas', 'fish', 'nood
>>> backpack[0]
'water'
>>> backpack[1]
'bananas'
>>> backpack[2]
'fish'
>>> backpack[3]
'noodle'
>>>
```

What do you think would happen if you as

what the seventh item is in the backpack
Go on...give it a try and see what happens

In IDLE, next to the prompt, type in:

backpack [6] and press **enter**.

What happens? Python responds with an error message

Traceback (most recent call last):

File "<pyshell#5>", line 1 in <module>

backpack [6]

IndexError: list index out of range

Python is telling us that the index is out of range

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
>>> backpack[0]
'water'
>>> backpack[1]
'bananas'
>>> backpack[2]
'fish'
>>> backpack[3]
'noodle'
>>> backpack[6]
Traceback (most recent call last):
  File "<pyshell#5>", line 1, in <module>
    backpack[6]
```

```
IndexError: list index out of range  
>>>
```

Chapter 07

How to Change Items in a List

Lists are very useful, because you can easily change items in the list. If you want to change something, you don't need to re-type the entire list.

Let's say that we want to change one of the items bananas, which is second in the list, or item 1 (according to Python). We want to replace bananas with mangoes. Instead of creating

Backpack[1] = 'mangoes' and press **enter** to

To check whether Python has made the change to

print (backpack)

How does Python respond? Has Python made the change?





Wow! Py
'mango
ir

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 19:21:23) [MSC
tel)] on win32
Type "help", "copyright", "credits" or "license()" for more info
>>> backpack = ['water', 'bananas', 'fish', 'noodle']
>>> backpack[0]
'water'
>>> backpack[1]
'bananas'
>>> backpack[2]
'fish'
>>> backpack[3]
'noodle'
>>> backpack[6]
Traceback (most recent call last):
  File "<pyshell#5>", line 1, in <module>
    backpack[6]
IndexError: list index out of range
>>> backpack [1] = 'mangoes'
>>> print (backpack)
['water', 'mangoes', 'fish', 'noodle']
>>>
```


Chapter 07

Activity: Strings and Arithmetic

1. If you type `23 + 4` into IDLE and press `enter`, Python will display:
 - A. `'23 + 4'`
 - B. `27`
 - C. `SyntaxError: invalid syntax`
 - D. None of the above.
2. If you type `'23 + 4'` into IDLE and press `enter`, Python will display:
 - A. `'23 + 4'`
 - B. `27`
 - C. `SyntaxError: invalid syntax`
 - D. None of the above.
3. If you type `'Hello' * 5` into IDLE and press `enter`, Python will display:
 - A. `'HelloHelloHelloHelloHello '`
 - B. `'Hello' 'Hello' 'Hello' 'Hello' 'Hello'`
 - C. `'HHHHHeeeeeellllloooooo'`
 - D. `SyntaxError: invalid syntax.`

4. `myfriends = ['Toyin', 'Bolu', 'Folu', 'Bayo']` is

- A. a string
- B. a string replication
- C. a string concatenation
- D. a list.

(*Note: The answers to this activity can be found at the end of the chapter.)

Solutions for Activity: Strings and Lists

Earlier in this chapter, you completed four multiple-choice questions to test your understanding of strings and lists. Here are the solutions:

1. If you type `23 + 4` into IDLE and press `enter`, Python will display:
A. 27.

2. If you type `'23 + 4'` into IDLE and press `enter`, Python will display:
A. `'23 + 4'`.

3. If you type `'Hello' * 5` into IDLE and press `enter`, Python will display:
A. `'HelloHelloHelloHelloHello '`.

4. `myfriends = ['Toyin', 'Bolu', 'Folu', 'Bayo']` is
D. a list.

Chapter 07

What is a tuple?

A tuple is like a list. It is a data structure where, unlike a list, a tuple is immutable.



Immutable? What on earth
'immutable' means.

Don't worry! 'Immutable'
'cannot be changed'. This
cannot change the
values in a tuple.



Ok, so that's what makes



We can change the data
cannot change the structure

A tuple is a way of storing a collection of data in Python.

- They are like lists, but with a key difference: values in the tuple.
- When creating a tuple, as a programmer you cannot be changed'.
- Tuples are useful, for example, when listing things that do not change.



Let's
to create a tuple

To create a tuple list, open IDLE, and next to the prompt type:

```
months = ('January', 'February', 'March', 'April')
```

Press **enter** (this will save the tuple). Then type:

```
months
```

Press **enter**. How does Python respond? It gives us:

['January', 'February', 'March', 'April']

Chapter 07

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc04
:52) [MSC v.1916 32 bit (Intel)] o
Type "help", "copyright", "credits
ore information.
>>> months = ('January', 'February
>>> months
('January', 'February', 'March', '
>>>
```

Note that in Python, a tuple uses round brackets (), while a list uses square brackets [].

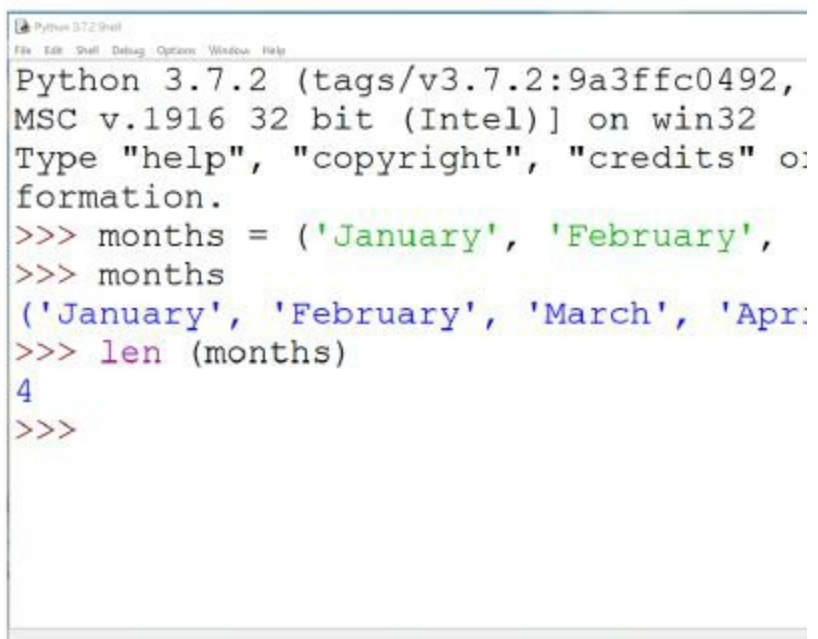
Did you know that just like with list you can find out the length of a tuple and you can access a particular item in a tuple?

How to Find Out the Length of a Tuple

To find out the length of a tuple, all you need to do is use the `len()` function that you use to find the length of a list. Type the following into the Python Shell:

`len(months)` and press **enter**.

How does Python respond? Python responds with the number of items contained in the tuple.



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
help() for more.
>>> months = ('January', 'February',
>>> months
('January', 'February', 'March', 'April')
>>> len(months)
4
>>>
```

How to Access Items in a Tuple

To access items in a tuple, you use the exact same syntax as in the previous chapter. For example, if you want to find the first item in the tuple, you would type the following into IDLE:

```
months[0]
```

Then press **enter**, and Python will respond with:

```
'January'
```

January

This means that January is the first item in the tu

Chapter 07

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492,
MSC v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
information.
>>> months = ('January', 'February',
>>> months
('January', 'February', 'March', 'Apr:
>>> len(months)
4
>>> months[0]
'January'
>>>
```

Try to Change an Item in a Tuple



Ok, you will remember
changes to a list, we
Let's check and
what happened
a change



Let's try and change the month 'January' in the 'December'. In IDLE type in:

```
months[0] = 'December'
```

You'll remember that we used this method previously. typing in months [0] 'December' we are telling Python to change the first element in the tuple (months) from 'January' to 'December'.

Python responds with an error message, to remind us that tuples are immutable:

TypeError: 'tuple' object does not support item assignment

```
Python 3.5.3 Shell
File Edit Shell Debug Options Window Help
Python 3.5.3 (v3.5.3:1880cb95a742,
[MSC v.1900 64 bit (AMD64)] on win32)
Type "copyright", "credits" or "license()" for more
>>> months = ('January', 'February', 'March', 'April')
>>> months
('January', 'February', 'March', 'April')
>>> len(months)
4
>>> months[0]
'January'
>>> months[0] = 'December'
Traceback (most recent call last):
  File "<pyshell#4>", line 1, in <module>
    months[0] = 'December'
TypeError: 'tuple' object does not support item assignment
```

```
-----  
TypeError: 'tuple' object does not  
>>>
```

Chapter 07

Wow!
Now I understand better!

What Is a Dictionary?



Oh, I know
A dictionary is the
with about 1,000
dictionary to find
we do



In Python, a dictionary is quite different to the dictionary that you use to find the meaning of words.

In Python, a dictionary is also known as a 'map'. Read on to find out more

In Python, a dictionary is a data structure that is used in the programming world as an **associative array**. Dictionaries

Dictionaries share some of the same characteristics:

- they are a collection of elements; and
- they are mutable, which means that they can be changed.

A key difference between dictionaries and lists is that they contain key-value pairs.

We access elements in lists by their position in the list.

With dictionaries, we access items through keys.

Chapter 07

Let's create a dictionary

Let's go back to the example where you introduced
of the game where the player is stranded on an island
you created a list of the foods that the player found
on the island and stored it in a list.

Now, let's use a dictionary to create a list of
people who have been stranded on an island.



Let's say that the names and ages of the people who

Names

| Name (Key) | |
|---------------|--|
| Asuku | |
| Ndukwe | |
| Tomi | |
| Seinde | |
| Zainab | |
| Yakub | |

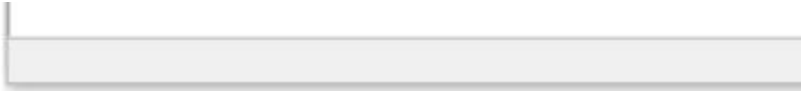
Open IDLE, and enter the names (keys) and ages (values) in the dictionary:

```
names_ages = {'Asuku':14, 'Ndukwe':12, 'Tomi':11, 'Zainab':11, 'Yakub':13}
```

Press **enter** to save the dictionary.



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019) 32 bit (Intel) on win32
Type "help", "copyright", "credits" or "quit()" for more.
>>> names_ages={'Asuku':14, 'Ndukwe':12, 'Zainab':11, 'Yakub':13}
>>>
```



Chapter 07

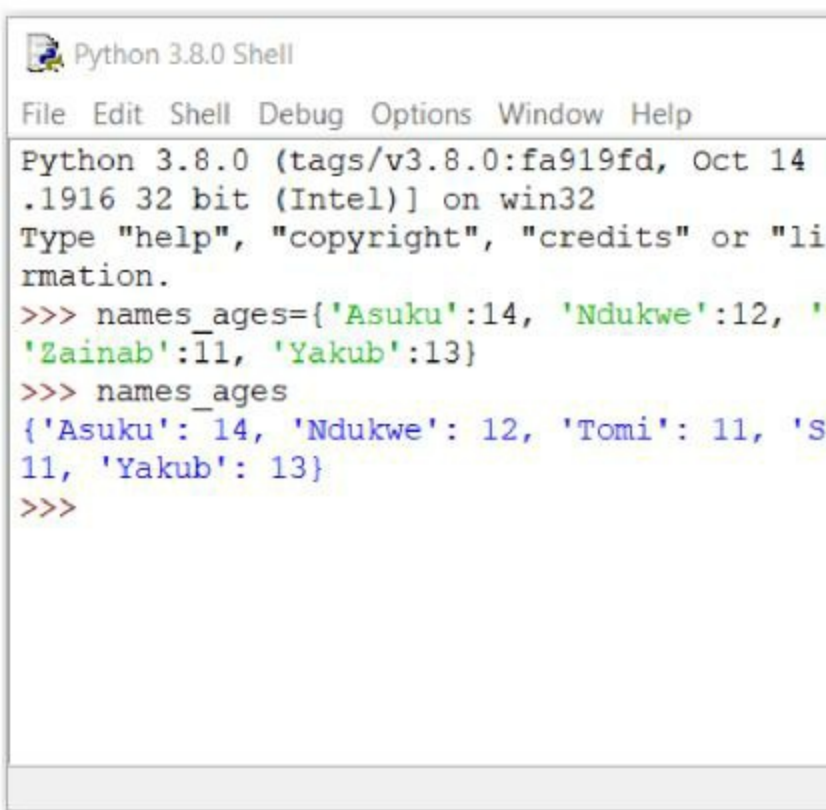
Note that when we create a dictionary, we use **colon** to separate keys from values. We also use **curly braces** { } to enclose the dictionary, and **single quotes** ' ' to enclose the keys, which are called squiggly brackets.

To check whether the dictionary has been saved, run the following command:

```
names_ages
```

Press **enter**. Python responds with:

```
{'Asuku':14, 'Ndukwe':12, 'Tomi':11, 'Seinde':11, 'Yakub':13}
```



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 19:16:32) [AMD64] on win32
Type "help", "copyright", "credits" or "license()" for more
>>> names_ages={'Asuku':14, 'Ndukwe':12, 'Tomi':11, 'Seinde':11, 'Yakub':13}
>>> names_ages
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11, 'Seinde': 11, 'Yakub': 13}
>>>
```



Cool! Let's
Let's ask it
st

To find out how old Seinde is, type in the fol

```
print (names_ages['Seinde'])
```

And Python responds with:

12

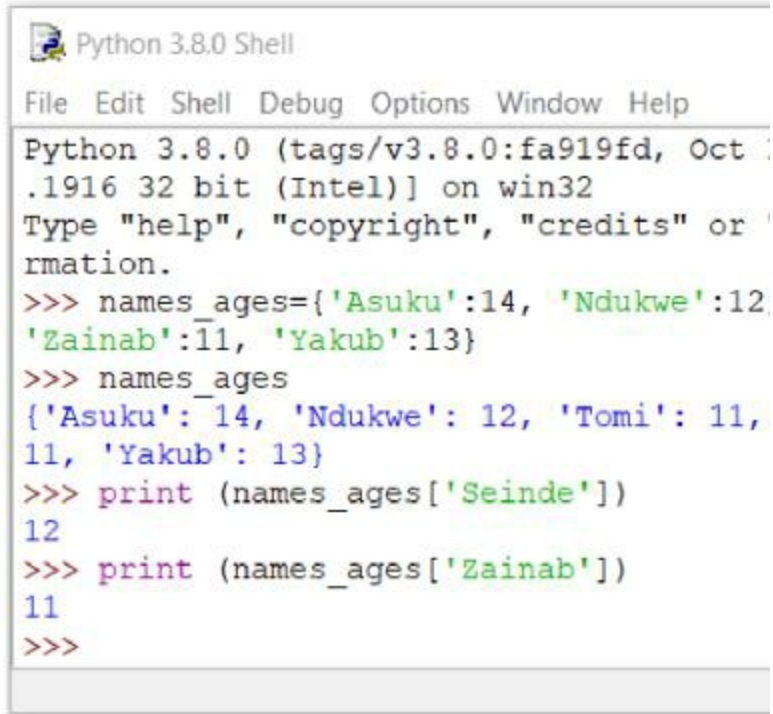
To find out how old Zainab is, type in the fol

```
print (names_ages['Zainab'])
```

And Python responds with:

11

Chapter 07



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 15:17:00) on win32
Type "help", "copyright", "credits" or "help()" for more.
>>> names_ages={'Asuku':14, 'Ndukwe':12, 'Zainab':11, 'Yakub':13}
>>> names_ages
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11, 'Yakub': 13}
>>> print (names_ages['Seinde'])
12
>>> print (names_ages['Zainab'])
11
>>>
```



When creating the dictionary, each name (key) must be unique and cannot be repeated.

keys are always single elements, values can be many things, like lists within lists, functions, etc.

Always use curly braces { } when creating a dictionary.

How to Add to a Dictionary

We are able to add elements to a dictionary. Let's add a new child who has been stranded on the island. Add a new element to the dictionary, in IDLE, type in:

```
names_ages['Azuka']=9
```

Press **enter**. To check if Python has added Azuka : 9 to the dictionary, type in:

```
names_ages
```

Press **enter**, and Python responds with:

```
{'Asuku':14, 'Ndukwe':12, 'Tomi':11, 'Seinde':12, 'Zainab':11, 'Azuka':9}
```



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
>>> names_ages={'Asuku':14, 'Ndukwe':12, 'Zainab':11, 'Yakub':13}
>>> names_ages
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11, 'Yakub': 13}
>>> print (names_ages['Seinde'])
12
>>> print (names_ages['Zainab'])
11
>>> names_ages['Azuka']=9
>>> names_ages
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11, 'Yakub': 13, 'Azuka': 9}
```

Chapter 07

How to Change Elements in a Dictionary

A dictionary, like a list, is mutable and so we are already able to change its elements.

Let's say that Ndukwe has just turned 13. To change the value of Ndukwe in the dictionary, we type in:

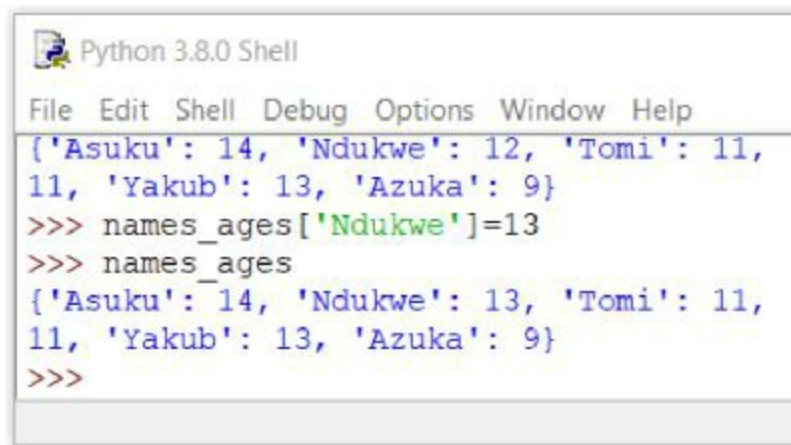
```
names_ages['Ndukwe']=13
```

Press **enter**. Then, to check if Python has changed the value of Ndukwe, we type in:

```
names_ages
```

Press **enter**. Python responds with:

```
{'Asuku':14, 'Ndukwe':13, 'Tomi':11, 'Seinde':12, 'Zack':12}
```



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
{'Asuku': 14, 'Ndukwe': 12, 'Tomi': 11, 'Seinde': 12, 'Zack': 12}
>>> names_ages['Ndukwe']=13
>>> names_ages
{'Asuku': 14, 'Ndukwe': 13, 'Tomi': 11, 'Seinde': 12, 'Zack': 12}
>>>
```

Python has changed Ndukwe's age to 13 in the names_ages dictionary.

Deleting Elements from a Dictionary

As a dictionary is mutable, we can remove or delete elements from it.

Let's say we want to delete Asuku from the names_ages dictionary using the `del` function (`del`). To do so, type in the following:

```
del names_ages['Asuku']
```

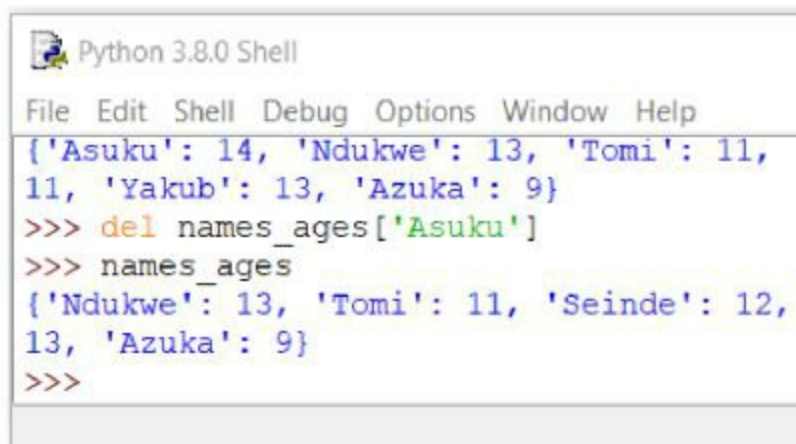
Press **enter**. To check if Asuku has indeed been removed, type in the following next to the prompt:

```
names_ages
```

Press **enter**. Python responds with:

```
{ 'Ndukwe':12, 'Tomi':11, 'Seinde':12, 'Zainab':13, 'Yakub':13, 'Azuka': 9 }
```

This shows that Python has removed Asuku, together with his age, from the names_ages dictionary.



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
{'Asuku': 14, 'Ndukwe': 13, 'Tomi': 11, 'Seinde': 12, 'Yakub': 13, 'Azuka': 9}
>>> del names_ages['Asuku']
>>> names_ages
{'Ndukwe': 13, 'Tomi': 11, 'Seinde': 12, 'Yakub': 13, 'Azuka': 9}
>>>
```


References:

The following sources were consulted in the pre

Payne, B. 2015. Teach Your Kids to Code. San Fr

Sweigart, A. 2015. Automate the Boring Stuff v
Starch Press.

Mulongu, C. 2019. 10 Interesting Facts About Py
Technotification. [ONLINE] Available at: <https://www.technotification.com/2019/01/interesting-facts-python-programming/>

Wentworth, P., Elkner, J., Downey, A.B., and Me
Computer Scientist: Learning with Python 3 Doc
Foundation.

Chapter 08

In this chapter, we are going to learn about

- ✓ what a loop is
- ✓ iteration over a list
- ✓ iteration over a dictionary
- ✓ how to use the range function.



In this chapter, we are going to

A loop is a great help to complete tasks
them to avoid repeating

Let's

What Is a Loop?

Loops are often used in computer programming, not just in programming languages. Loops are a set of instructions that repeat a number of times until a process is completed, or until a condition is met. They help programmers to repeatedly execute a block of code over and over again, and they save time as you don't have to write the same code multiple times.

"For loops" and "while loops"

In this book, we will look at two loops: the **for loop** and the **while loop**.

A **for loop** is used to repeat a sequence of instructions for a specific number of times. The **for loop** executes a piece of code, for a specific number of times.

There is also the **while loop**, which executes until a condition is met. A **for loop** is a loop of a specific length, whereas a **while loop** doesn't know ahead of time when it will need to stop.



Loop
I hate having to do the same thing
again! If a loop is used, it can be
done once, without having to be
to be



Chapter 08

Sure, Let's have a closer look at the `for` loop.
Suppose you want to develop a program that prints a name eight times. What would you enter into Python?

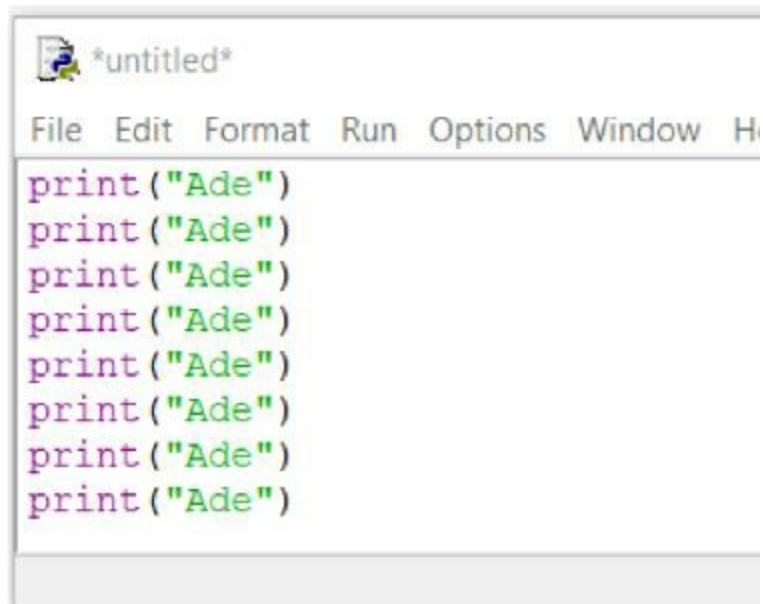


Maybe I can
the function
L

Open up IDLE, and select **File**, and then select **New**.
enter the following code:

```
print("Ade")
```

```
print("Ade")  
print("Ade")  
print("Ade")  
print("Ade")  
print("Ade")  
print("Ade")  
print("Ade")  
print("Ade")
```



Now save the program to your desktop by choosing **File > Save**. You will be prompted for a file name, so enter **Ade_Eight.py**. Then choose **Run, and Run Module**. The program will then print the name **Ade** eight times.

Chapter 08

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019) [AMD64] on win32
Type "help", "copyright", "credits" or "license()" for more
>>>
===== RESTART: C:/Users/ayoolabi
=====
Ade
Ade
Ade
Ade
Ade
Ade
Ade
Ade
Ade
Ade
>>>
```



Oh v
That was so boring
eight times to cre
fun at all! Isn't t
way



Yes, there is! We can create this program much faster using **for loop**.
Let me show you how.

You can write a very simple programme that loops loops. To do this, open IDLE and type in:

```
for i in range(8):  
    print("Ade")
```

Press **enter** to save the code. Then press **enter** again.

Ade

Ade

Ade

Ade

Ade

Ade

...

Ade

Ade

Chapter 08

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019
it (Intel)) on win32
Type "help", "copyright", "credits" or "licens
>>> for i in range (8):
    print ("Ade")

Ade
Ade
Ade
Ade
Ade
Ade
Ade
Ade
Ade
>>>
```



That is so cool
writing out
I am going

Let's have a look and learn :

Let's have a look and learn:

```
for i in range(8):  
    print("Ade")
```

It is extremely important
that indentations are spaced
correctly. Note the four spaces

- **for** and **in** are keywords for the **for loop**. The
- The **i** in the code is a count, or number variable, of objects, such as a string, list or tuple. Python uses **i** as a loop variable. The **i** stands for the loop turn or when. For example the **i** refers to the code **print("Ade")**
- The **range(8)** indicates that **print("Ade")** must be repeated 8 times.
- Take note of the colon (:) that is at the end of the line. You don't leave out this colon.
- In this example, **print("Ade")** is what must be repeated. Note that **print("Ade")** is indented, and that the word **print** is a function.

Iteration Over a List

'Iteration'? What on earth does
'iteration' mean?

Why does Python have to use all
these big words? It makes my head hurt!

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Don't feel stressed! '*Iteration*' for a loop. For example, when you use the function `print("Ade")`, the function is iterated, or looped. The result will be printed on the screen



Techopedia defines *iteration* as 'a process wherein a set of instructions is repeated in a sequence a specified number of times. If the first set of instructions is executed again, it is called iteration.'

(<https://www.techopedia.com/definition/3821/iteration>)

Let's now look at how to iterate over a list.

Can you remember what a list is?



Of
A list is a c
is orde
Mutable

Wow, I'm impressed! It's great that
you can remember what a list is.

Well done!

We will create a new list, this time of colours: white
loop to iterate through, or loop through, this list.

Open IDLE, and type in the list:

```
colour = ['white', 'green', 'blue', 'yellow']
```

Press **enter** to save the list.

Now, to iterate through the list, type in the follow

```
for i in colour:
```

```
for i in colour:
```

```
    print(i)
```

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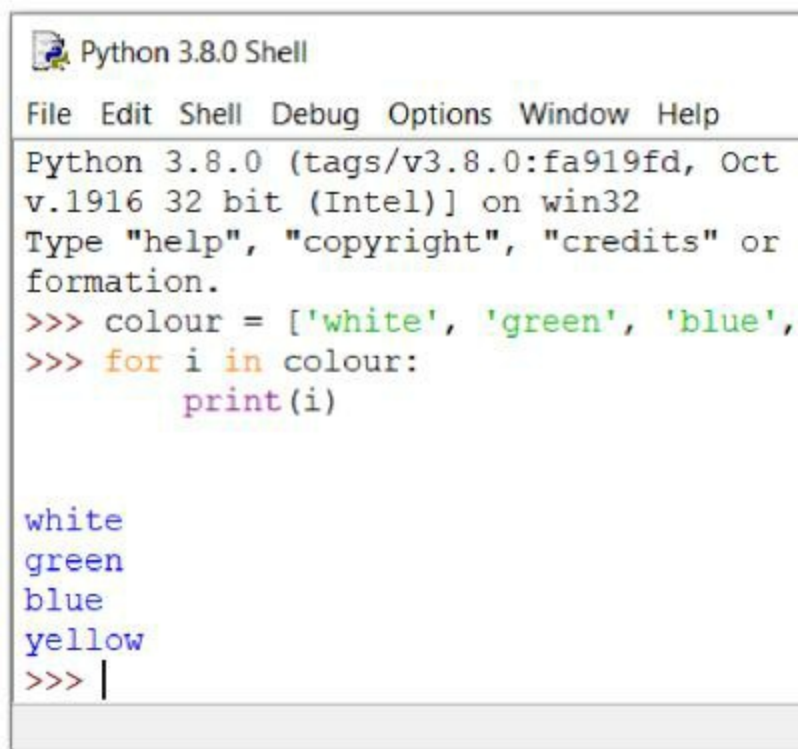
Press **enter** to save the code. Then press **enter** again displaying the items in the list:

white

green

blue

yellow

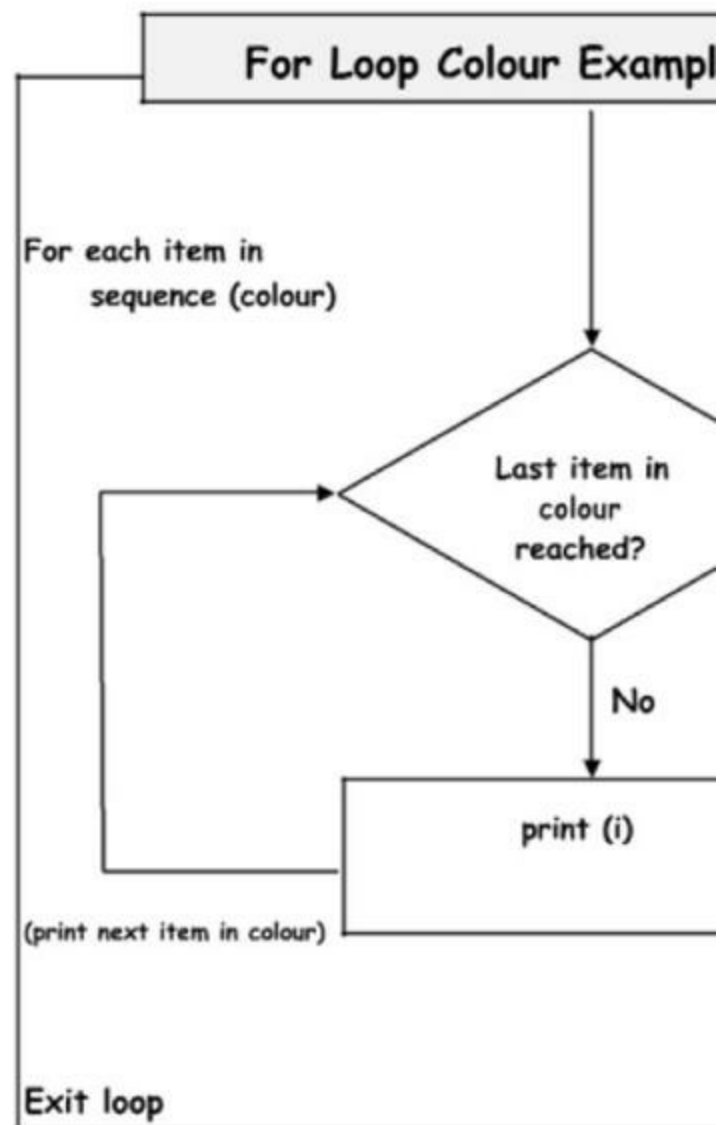


```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Python 3.8.0 (tags/v3.8.0:fa919fd, Oct
v.1916 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or
formation.
>>> colour = ['white', 'green', 'blue',
>>> for i in colour:
>>>     print(i)

white
green
blue
yellow
>>> |
```

So the code that you have developed tells the computer to iterate through the variable `i` and then to print the contents of the

the variable `i`, and then to print the contents of the



Chapter 08

Iteration Over A Dictionary



Now that we know
a list, let's try to iterate over it.
Can you remember how to do this in Python?

I do remember! A dictionary
is an unordered collection of
key-value pairs.

There are a number of ways to iterate over a dictionary:

- you can iterate through all the keys; and
- you can iterate through all the values.

Iteration Through Keys

First, let's look at how to iterate through all the keys of a dictionary based on different types of animals in a "zoo" dictionary by typing in:

```
zoo = {'Lion':25, 'Tiger':9, 'Elephant':3, 'Monkey':1, 'Birds':10}
```

Press **enter** to save the dictionary.

Now let's iterate through all the keys. To do this,

```
for i in zoo:
```

```
    print(i)
```

Press **enter** to save the code. Then press **enter** again to print the keys from the dictionary:

Lion

Tiger

Elephant

Monkey

Birds

Chapter 08



```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Type "help", "copyright", "credits" or "r
mation.
>>> zoo = {'Lion':25, 'Tiger':9, 'Elepha
ds':69}
>>> for i in zoo:
        print(i)

Lion
Tiger
Elephant
Monkey
Birds
>>>
```

What you can see in the example above is that when the loop variable (*i*) is assigned to the dictionary keys (the animals in the zoo).

Iteration Through Values

That's a good question!

Let me show you how

Let me show you how.



Hmm, so if
the dictionary
a dictionary, how

You can access the dictionary's values with the **for**

In IDLE, type in:

```
for i in zoo.values():  
    print(i)
```

Press **enter** to save the code. Then press **enter** again for
printing the values in the dictionary:

25

9

3

EA

54

69

Chapter 08

```
Python 3.8.0 Shell
File Edit Shell Debug Options Window Help
Tiger
Elephant
Monkey
Birds
>>> for i in zoo.values():
        print(i)

25
9
3
54
69
>>>
```



Wow! P
Okay, so now I
the keys in a dic
also know how to
a dictionary



Using the Range Function

Let's say we wanted to iterate the values 1 to 15. type the following into IDLE:

```
for x in (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,
        print(x)
```

Press **enter** to save the code. Print **enter** again to Python responds with:

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
```


14

15

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```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 2.
32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "lic
>>> for x in (1,2,3,4,5,6,7,8,9,10,11,12,13
      print(x)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

No way! That involves far too
I thought you said that using for
of reducing the amount of
to type?

Yes! **For loops** do reduce the amount of code that a computer has to execute to iterate the way by using the **for loop** with `range()`.
Let me show you



We can use the range function with **for loops** to iterate through a sequence of numbers in Open IDLE, and type in:

```
for x in range (1,16):
```

`print(x)`

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Press **enter** to save the code. Then press **enter** with:

1

2

3

4

5

6

7

8

9

10

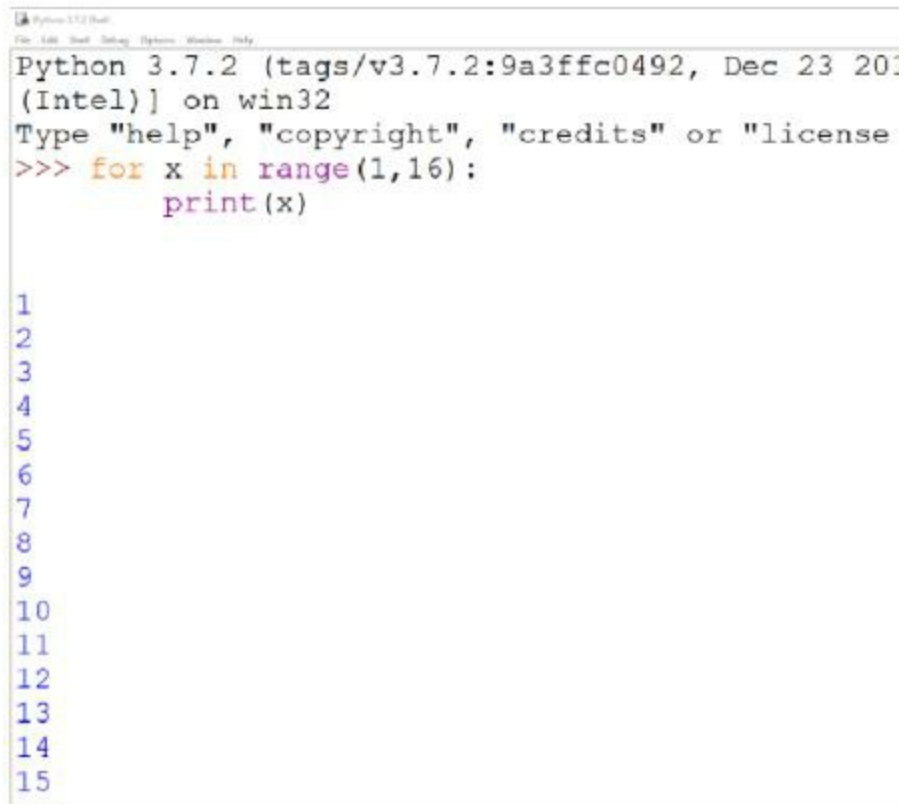
11

12

13

14

15



```
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2019)
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 23 2019) on win32
Type "help", "copyright", "credits" or "license()"
>>> for x in range(1,16):
    print(x)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Cool! So, using the range function with the **for loop** numeric values!

Here's another example showing how we can use the range function to generate a sequence of numbers. If we want to generate the numbers from 3 to 21, in IDLE, type the following into IDLE:

```
for x in range (3,22,3):
```

```
    print(x)
```

Press **enter** to save the code. Then press **enter** to

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Python responds with:

3

6

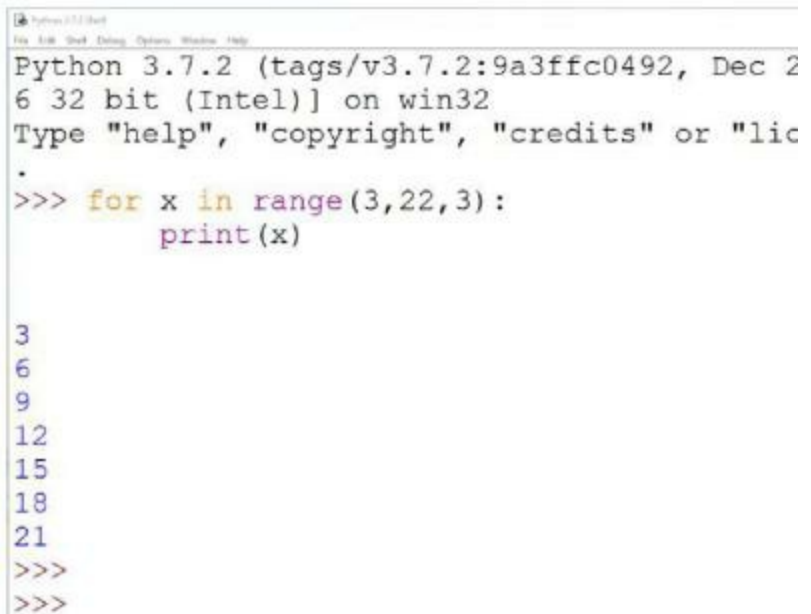
9

12

15

18

21



```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc0492, Dec 2
6 32 bit (Intel)] on win32
Type "help", "copyright", "credits" or "lic
.
>>> for x in range(3,22,3):
        print(x)

3
6
9
12
15
18
21
>>>
>>>
```

In this example, three numbers are contained in the range, i.e. `range(3,22,3)`:

- the first number (3) in the brackets refers to the start of the iteration
- the second number (22) in the brackets refers to the **last number that the iteration must end on**
- the third number (3) in the brackets refers to the step of each iteration. In other words, how much each iteration increases or decreases by



Now, let's try something fun using the range function.
Do you know the children's song "5 little monkeys jumping on the bed"?
Well, let's write some code so that we can print out the lyrics of the song.

In IDLE, type in:

```
for x in range (5,0,-1):  
    print (x, 'little monkeys jumping on the bed')
```

mama called the doctor and the doctor
bed'!)

Chapter 08

Press **enter** to save the code. And then press **enter** with the song, which counts down from 5 monkeys jumping on the bed:

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
>>> for x in range(5,0,-1):
        print(x, 'little monkeys jumping
bumped his head, mama called the doctor a
monkeys jumping on the bed!')
```

5 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
4 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
3 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
2 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!
1 little monkeys jumping on the bed, 1 fe
mama called the doctor and the doctor sai
on the bed!

Multiple Choice A

1. Which of the following statements is false?

- A. Loops save time when developing computer
- B. Loops reduce the amount of repetitive code
- C. Loops increase the amount of repetitive code
- D. One type of loop is the for loop.

2. Which of the following lines of code will print

A. `for i in range(x):`

`print("Peter")`

B. `for i in range(1-1):`

`print("Peter")`

C. `for i in range(11)`

`print("Peter")`

3. Which of the following is the correct code to iterate over a dictionary?

A. `for i in grocery_list:`

`print(i)`

B. `for i in grocery_list.values():`

`print(i)`

C. `for grocery, price in grocery_list.items():`

`print(grocery, price)`

D. None of the above

(*Note: The answers to this activity can be found at the end

(Note: The answers to this activity can be found at the end of the activity.)

Practical Activity

1. Going Loopy With Your Age

- If your age is currently an even number, count by 2s until it reaches your age.
- If your age is currently an odd number, count by 3s until it reaches your age.

2. Let's Go Shopping!

Your mom has asked you to go shopping. She has given you a list of the names of the items that you must buy, as well as

| Grocery Item | |
|--------------|--|
| Apples | |
| Eggs | |
| Bread | |
| Potatoes | |
| Tomatoes | |

2.1 Create a dictionary for your mom's groceries.

2.2 Once you have created the dictionary, use

- iterate through the keys.
- iterate through the values.

(*Note: The answers to this activity can be found at the end of the chapter.)

Solutions for Multiple Choice Questions

Earlier in this chapter, you completed three multiple-choice questions to test your understanding of loops and iterations.

Here are the answers to that activity:

1. Which of the following statements is false?

C. Loops increase the amount of repetitive code.

2. Which of the following lines of code will print the name of the pet?

D. `for i in range(11):`
`print("Peter")`

3. Which of the following is code to iterate through the values of a dictionary?

B. `for i in grocery_list.values():`
`print(i)`

Chapter 08

Solutions for Practical Activities

1. Going Loopy with Your Age

Two sample answers for this activity are provided

- The one sample answer is for a person who (an even number).
- The other sample answer is for a person who (an odd number)

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc040:52) [MSC v.1916 32 bit (Intel)]
Type "help", "copyright", "credits" or "help()" for more information.
>>> for x in range(2,11,2):
    print(x)

2
4
6
8
10
>>>
```

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
>>>
>>> for x in range(1,14,2):
    print(x)
```

```
1
3
5
7
9
11
13
>>>
```

2. Let's Go Shopping

The model answer to this activity is provided below

```
Python 3.7.2 Shell
File Edit Shell Debug Options Window Help
Python 3.7.2 (tags/v3.7.2:9a3ffc04
20:52) [MSC v.1916 32 bit (Intel)]
Type "help", "copyright", "credits"
for more information.
>>> grocery_quantity={'Apples':12,
, 'Potatoes':12, 'Tomatoes':4}
>>>
>>> for i in grocery_quantity:
    print(i)

Apples
Eggs
Bread
Potatoes
Tomatoes
>>>
>>> for i in grocery_quantity.values():
    print(i)

12
```

6
2
12
4

Chapter 08

```
>>> for grocery, quantity in groceries.items():  
    print(grocery, quantity)
```

```
Apples 12  
Eggs 6  
Bread 2  
Potatoes 12  
Tomatoes 4  
>>>
```

Well done!

*You've learnt so much about Python
Programming. I hope you enjoyed this chapter
as much as I did!*

References:

The following sources were consulted in the preparation of this chapter:

Pal, S. 2017. Python Loops Tutorial. [ONLINE] ,
<https://www.datacamp.com/community/tutorials/python-loops>
(Accessed 2 May 2019).

Sturtz, J. 2019. Python "for" Loops (Definite Iteration). [ONLINE] <https://realpython.com/python-for-loop/#num>
(Accessed 2 May 2019).

Sweigart, A. 2015. Automate the Boring Stuff
Starch Press.


Teach Your Kids to Code (2018). So You Want to Teach Your Kids to Code!
Kids! <https://teachyourkidscode.com/learn-python-for-kids-creating-a-for-loop>
(Accessed 2 May 2019).

Techopedia. 2019. What is Iteration? [ONLINE] [techopedia.com/definition/3821/iteration](https://www.techopedia.com/definition/3821/iteration) (Accessed 2 May 2019).

Wentworth, P., Elkner, J., Downey, A.B. and Meeker, D. 2015. Computer Scientist: Learning with Python 3 Documentation. No Starch Press.



1million African AI talent in 10 years:



The Data Science Nigeria
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OUR
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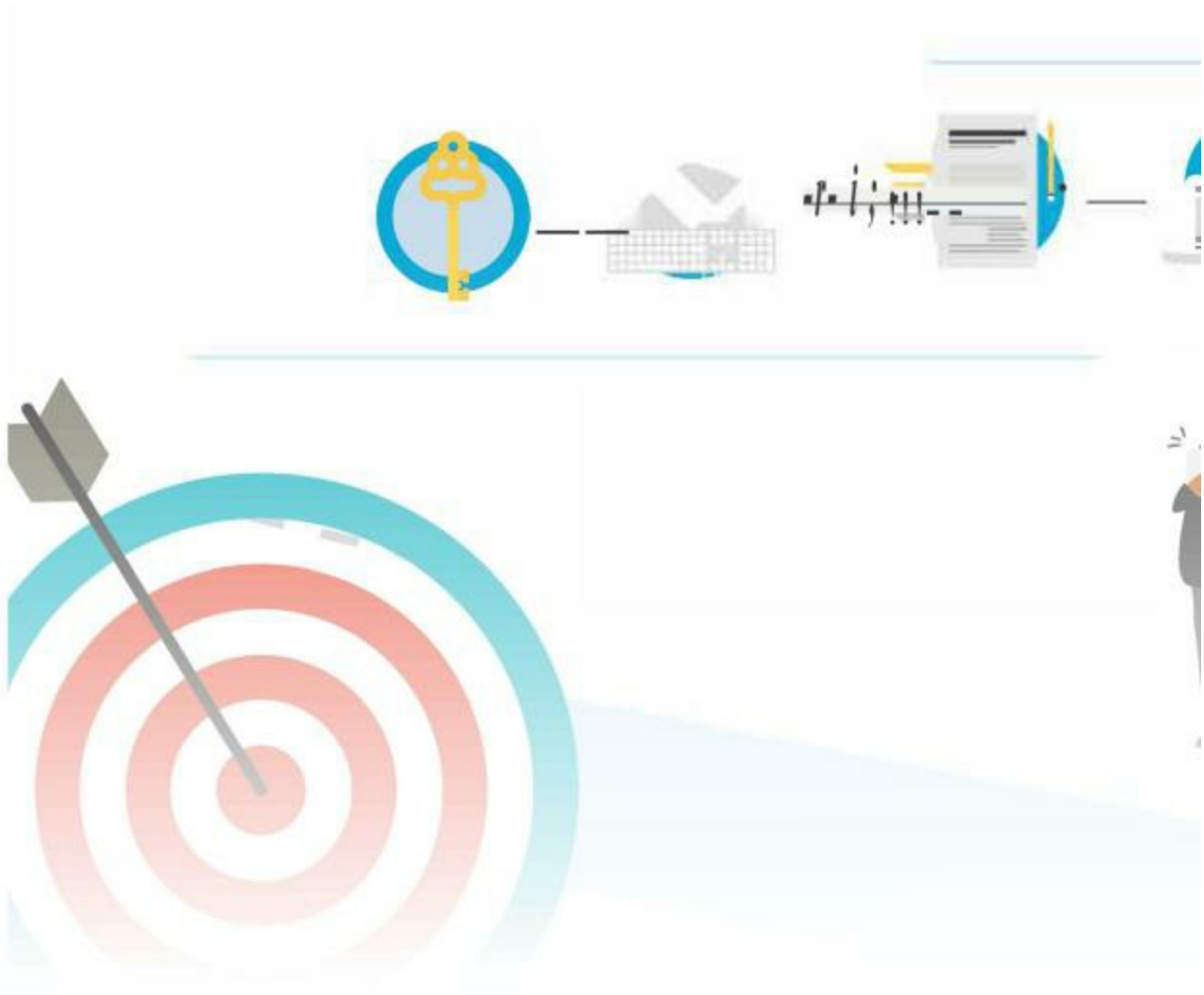
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OUR VISION

To build a world-class Artificial Intelligence research and innovation ecosystem that impact transformational research, business applications, AI-first start-ups, support social good use cases. We are committed to million AI talents in 10 years and thus position Nigeria as one of the top 10 AI talent/knowledge destinations with a GDP multiplier impact.

We are poised to accelerate Nigeria's socio-economic development through a solution-oriented approach to machine learning in solving social/business challenges, galvanize data science/Artificial Intelligence revolution, which will position Nigeria as a global hub for global projects.



OUR
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OUR PLATFORMS

first of its kind
initiatives built
from Nigeria



- 1st Intercampus Machine Learning conference
- Artificial Intelligence Bootcamp
- Artificial Intelligence Summer school for students
- Free AI ebooks
- AI+ Knowledge Box
- AI+ Clubs in secondary and universities
- Deep Learning Nigeria
- Artificial Intelligence for Executive Education
- Artificial Intelligence Hub
- Pan-Nigerian Data Collection apps (text, picture, video and sound)
- AI Invasion – Introductory Machine Learning course

Nigerian cities

- AI+ Researchers Network
- AI+ Professional Meet-Up
- AI Wednesdays
- AI Classes for post-secondary schools
- AgroAI Lab, Yaba, Lagos
- Financial Inclusion Lab, Victoria Island
- AI Masterclass
- Artificial Intelligence Summit
- DataHacks – Hackathon focussed on ir
- Business Analytics Masterclass for Pro
- AI Everyday Free classes
- Pre-University Students AI Classes
- Business Analytics for Professionals
- Data Science Consulting
- Pan Nigeria Data Collection with Data
- Etc



03

BUILDING 1MILLION
AFRICAN AI TALENT
IN 10 YEARS:



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Thomas G. Dietterich an

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in Data Scier
courses – fr

Machine Learning
competition

courses + the
registration to
least one cla



300+ direct jobs
placement,
project participation
and internship

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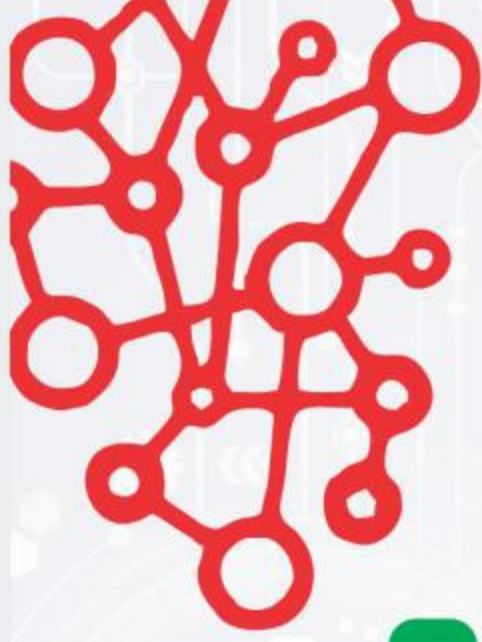
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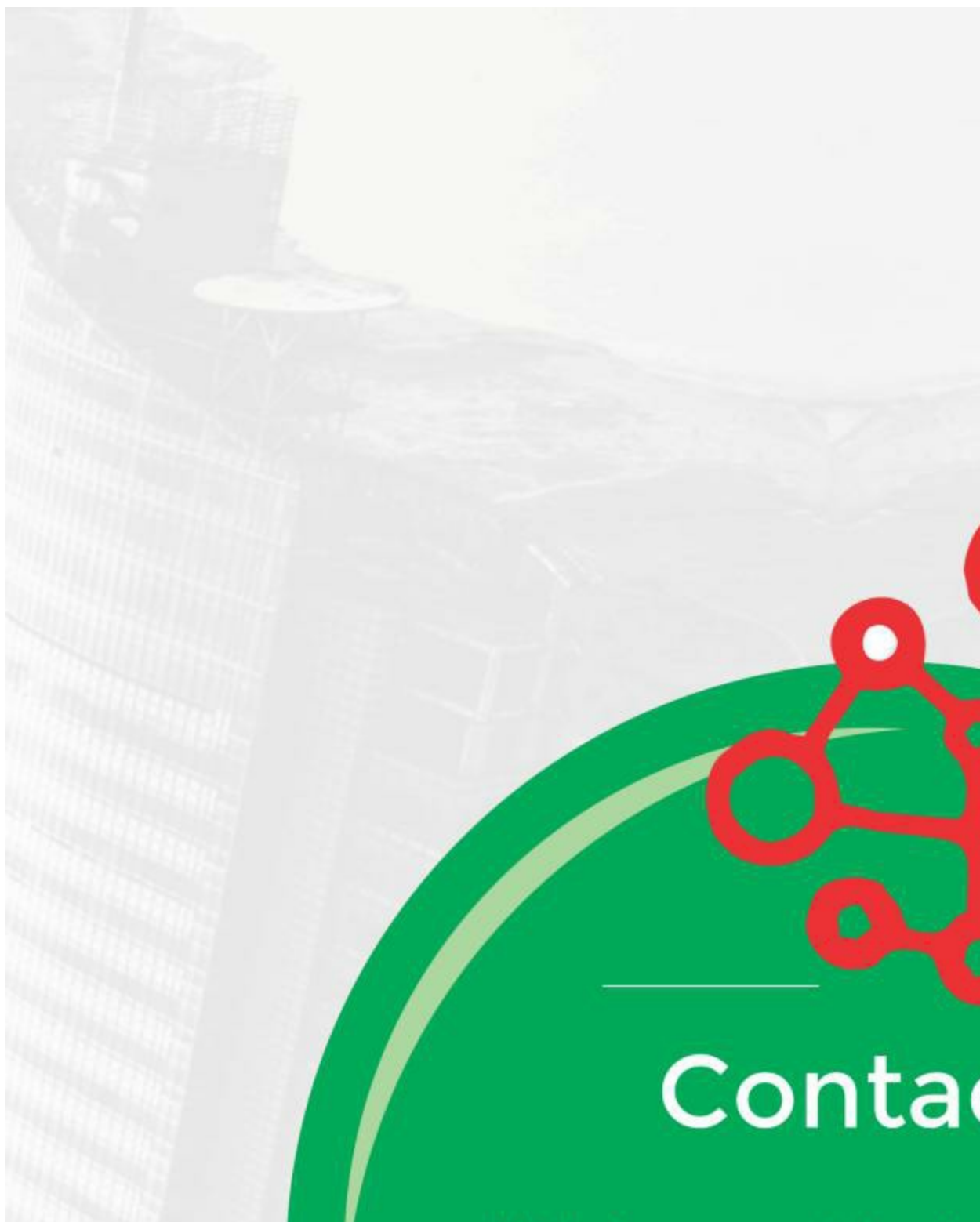


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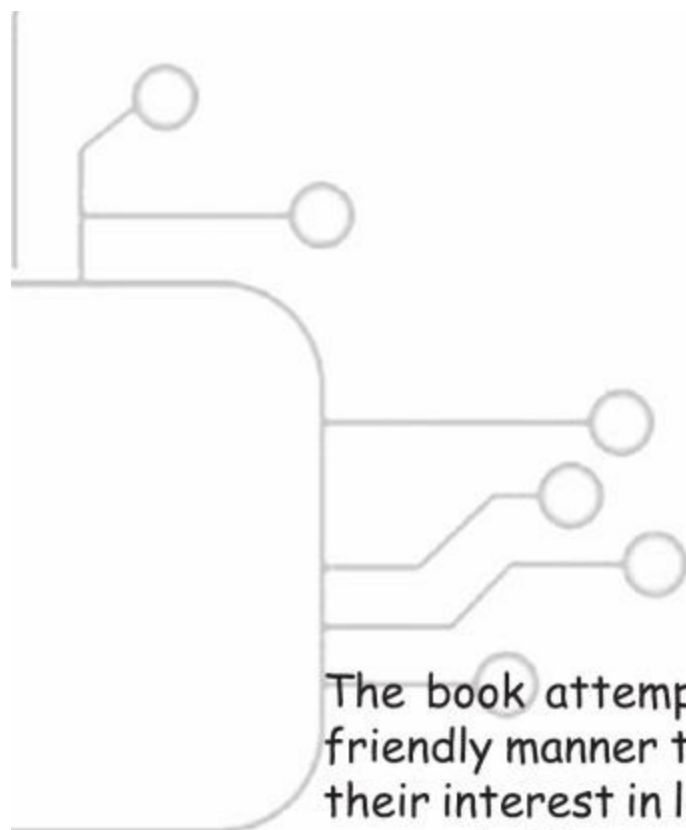
Contact

Website: www.datasciencecenter.org

Email: info@datasciencecenter.org

Twitter: [DataScienceCenter](https://twitter.com/DataScienceCenter)

Instagram: Datascie
Facebook: facebook.com,
YouTube: https://go
Phone: 0814000
+2348032018



ABOUT

The book attempts to demystify the concepts in a friendly manner to kids, with the goal of stimulating their interest in learning about AI. After the initial concepts like machine learning, deep learning, etc., students are guided into step-by-step programs. The goal is to transit beyond the traditional code-first approach to concepts that will sufficiently motivate a desire to learn coding skills does not require a university degree. Like any other language, the sooner you start learning, let's get started!



ABOUT THE AUTHOR

Olubayo Adekanmbi is a leader in Artificial Intelligence and Data Science, who comes with over 10 years of experience in two largest e-commerce companies in Africa) with robust doctorate



AI application development. first society where Artificial problems, particularly the sustainable millennial g Nigerians, and Africans, as a result. He believes AI immense opportunities of the fourth industr competitiveness in the emerging digital world. He Data Science Nigeria, a non-profit foundation, an Officer at MTN Nigeria, where he leads enterpr sustainable business growth and innovation. Ade books, The Future is Shared: The Sharing Econor Markets and Artificial Intelligence Simplified: 991

